ANNUAL RATES OF SUBSCRIPTION.

Farmers, Graziers, Horticulturists, and Schools of Arts, One Shilling. Members of Agricultural Societies, Five Shillings, including postage. General Public, Ten Shillings, including postage.

VOL. XXXVIII. 1 DECEMBER, 1932. PART 6.

Event and Comment.

St. Lucia Farm School.

AT a conference in the course of the month of representatives of Government departments and interested citizen organisations, convened by the Minister for Agriculture and Stock, Mr. Frank W. Bulcock, and at which he presided, a scheme for training boys for land pursuits was approved unanimously. In outlining the scheme, Mr. Bulcock said that he considered it would be fatal to the scheme if the Government were to embark on it unless it had the definite assurance that the lads would be placed in work on the land once they had passed through the training farm. Therefore, he had enlisted the aid of outside public bodies and of the officers of other Government departments, seeking their advice and co-operation. They had one common objective—the provision of some form of training that would fit for life on the land boys for whom at present there were no city industrial vocations, and to so stem the flow of population as to, in some measure, adjust the balance between the bush and the city. In the tentative curriculum provision was made for both animal husbandry and general agriculture—a good general rudimentary training. The object also was to raise at St. Lucia as much as possible of the foodstuffs required there. It would be a testing ground for the boys, and the right would be reserved to eliminate those who obviously did not possess an agricultural sense and were not fitted for the work.

The Public Service Commissioner, Mr. J. D. Story, I.S.O., submitted comprehensive proposals under which the period of training in the farm school would be, approximately, six months for each group of selected boys, the places to be made available in the first place for fifty suitable boys. Expensive buildings and equipment would be taboo, and as far as possible marketable commodities would be produced. The layout would be on a systematic plan. The main essentials of the scheme are:—The selection of lads suitable for farm work and eager to learn farm routine; the provision of a course of training which, besides being attractive, would enable the boys on the completion of the course to take an intelligent and efficient part in general farm work; and the absorption of the boys by the farming industries

on the completion of their training. Failure in any one of these directions, said Mr. Story, would undoubtedly wreck the scheme and result in wasted effort and expenditure. All should wholeheartedly co-operate and work for co-ordinated action. So that a definite scheme embracing these essentials might be evolved, he suggested the creation of a provisional general committee out of which should be appointed:—(1) A recruiting committee; (2) a farm programme committee; (3) an employment committee. He emphasised that there must be a continuous supply of boys, not merely at the start, but every six months thereafter, and that to ensure that there must be an organisation to recruit them, and also to fill the places of any that might fall out.

The proposals were discussed very fully and the outcome of the conference was the appointment of a general advisory committee with power to add to its number. From this committee the suggested sub-committees were formed. These sub-committees met subsequently and each has since reported to the general advisory committee, by which every report was adopted after serious consideration.

The recruiting committee recommended that the age of trainees should be between fifteen and twenty years, and that physical fitness should be determined by personal interview, and, if necessary, by medical examination. The educational standard was fixed at fifth grade in primary schools. It was decided to send to representative organisations a circular directing the attention of unemployed boys to classes at the Central Technical College with a view to their ultimately entering the St. Lucia Farm School on the University land at St. Lucia.

The programme committee's report concerned the layout of the ground, accommodation, equipment, and other details. It was recommended that the boys should be instructed in mixed farming, dairying, and poultry and pig-raising at St. Lucia, and in general timber work at Moggill on land which also belongs to the Queensland University.

The report of the employment committee dealt with the placing of boys after they have completed their period of training, and its recommendations followed closely along the lines employed by the New Settlers' League and the Immigration Department. It was decided to ask prospective employers to get in touch with the central committee and the employment committee.

Final preparations are now in hand and the school will open on 30th January. Already forty-eight applications have been received from boys desiring to take advantage of the course of training offered and no difficulty in getting the required number for each term is anticipated. An executive, consisting of the Minister and the conveners of the several sub-committees, will confer on additional details. No fees will be charged and tram and ferry fares will be provided for day students.

The wisdom of the Minister in initiating the scheme has been commended widely in the public press and by citizens generally. The best brains, the most thoughtful men and women of the community are searching for some means of giving boys leaving school a definite place among the nation's workers. It is generally felt that a practical effort must be made to readjust our lopsided distribution of population, and Mr. Bulcock's scheme, which, though necessarily limited in scope in its initiatory stages, is capable of vast extension, is regarded as a movement in the right direction. The transference of town boys to the country, where they will gain practical experience and an agricultural bias, is regarded as a preliminary to their becoming either share farmers or producers on their own holdings. Every intelligent citizen must realise that it will be many a long day before city industries can absorb any more than a small proportion of the boys turned out annually from our schools, so the land offers, obviously, the only way out. The direction of the minds of our youths to rural occupations cannot, however, be regarded merely as a temporary expedient, but as a first step in a movement back to the land in which is bound up inextricably our future as a nation.

Our Economic Problems.

"THERE is in the world to-day great depression and very serious unemployment. We all realise that this is due to no mere cyclical depression to be cured by one or two harvests. We have to look further for cause and cure." In those words His Excellency the Governor, Sir Leslie Orme Wilson, speaking on the general economic situation at a gathering of city men in the course of the month, expressed what is in the minds of all thoughtful citizens. On the suggestion that there can be but one remedy for a greatly diminished national income—namely, reduced expenditure—a reduction to be shared by all sections of the community—he hesitated to agree that that was the only remedy, and felt inclined to think that such a course must greatly aggravate the present unemployment situation in the world.

His Excellency proceeded to quote from a speech by the Prince of Wales when addressing the International Congress of Commercial Education. The Prince declared that the world-wide trade depression and economic disturbance had been largely caused by maladjustment of distribution, and concluded by saying: "Our urgent task is to bring consumption and production into a proper relationship—not a simple but quite a possible task."

He added: "I believe there is a way other than creating more unemployment by rigid economy, by means of which the producer of raw materials and primary products, the workman and the agriculturist will be able to obtain a reasonable reward for his work and enterprise, and so enable him to buy again the manufactured goods of the work bench and shop."

The Dairy Industry—A Five-Year Plan.

SPEAKING at a recent gathering of West Moreton farmers, the Minister for Agriculture and Stock, Mr. Frank W. Bulcock, said that the sugar industry had made wonderful progress, due to the application of scientific principles to the industry, and the same applied to sheep and wool. With the dairying industry they might reasonably ask themselves if everything that could be done had been done. There were three things they had to consider—first, the testing of herds from the production point of view; second, the survey of herds from the health point of view; and the third, the marketing of the products resulting from the correct application of the first two principles. The department considered herd-testing of paramount importance. In Denmark thirty years ago the average production per cow was exactly the same as we had in Queensland to-day. Thirty years gave them a long-range view of the question, and in that time in Denmark they had increased their production 100 per cent., from 147.9 lb. butter-fat per cow to just over the 300 mark, and yet the climatic conditions of Denmark were no better than Queensland. They had been conducting herd-testing in this State in a very limited way. Leaders in the dairying industry all said that one of the greatest difficulties that was being encountered was the poor type of bull that was being used.

The dairy farmers were looking for a lead, and he proposed to set up a board to administer a scheme to deal with various phases of the industry. He believed he could get a long way further with the farmers if he entrusted this work to farmers' representatives. He proposed, therefore, a board of three people—two representatives of the industry, and the Chief Dairy Expert of the State, Mr. McGrath. He had in his mind a tentative scheme for five years, and estimated the cost to the department at £10,000 a year.

The time had come when the dairying industry was of sufficient magnitude to have its own health service, and he proposed to appoint two veterinarians specially for the work. He did not want to tell farmers that they had to abandon the unproductive cow, but he proposed, where the farmer concurred, that the veterinary surgeon should spey the cow. The scheme meant the registration of every bull in the State, at a registration fee of 5s. per bull. The second year would probably mean elimination of certain bulls, and the replacement of these bulls from the fund. The first year would be an organising year, and the third year would find them with a sound progressive scheme, and he did not believe it would ever be abandoned. If they gave him their full co-operation he was sure he could bring the scheme into effect. If only one arm of the service succeeded, they would be repaid a hundredfold.

Bureau of Sugar Experiment Stations.

CANE PEST COMBAT AND CONTROL.

THE GREY-BACK BEETLE.

By EDMUND JARVIS.

It is proposed to publish each month a short paper describing the movements of this insect, either above or below ground, according to the time of the year; together with descriptive details of a nature calculated to assist canegrowers in the study of this pest in every stage of its life cycle. Mr. Jarvis's entomological notes are always interesting, and this additional monthly contribution will be welcomed by our readers who are engaged in the sugar industry.—EDITOR.

DURING December grey-back cane beetles can generally be found on their various feeding trees, such as the Figs and the so-called "Moreton Bay Ash," besides other favourite food plants.

In years when this cane pest chances to emerge in November its first-stage grubs can be found amongst the fibrous feeding roots of cane in late December.

HABITS OF THE GREY-BACK COCKCHAFER.

A few hours after a fall of from 3 to 5 inches of rain (which usually occurs towards the end of November or middle of December) the awaiting host of grey-backs, acting under the stimulus of such moisture, start to tunnel upwards through the ground until reaching the top 2 inches of surface soil, where they remain until daylight has given place to semi-darkness.

Emergence takes place about 7.15 p.m., at which time a wave of unrest apparently induces activity in every beetle simultaneously, causing the swarming multitude to crawl excitedly out of the ground on to the surface to extend their now quivering antennæ, spread their elytra and large membranous wings, and finally to mount into the air to enter upon their winged or perfect state.

> Thenceforth 'mong fragrant gums to freely roam,
> And taste the glories of their native home.

Having exercised their wings for an hour or two, the main body settle amongst twigs and branches of the nearest trees, where copulation takes place the same evening at a height of 15 to 20 feet from the ground, after which they usually fly about again for a time until finding suitable food plants. During the succeeding ten to fourteen days, while the ovaries are developing, these beetles live a free arboreal life, many hours of daylight, however (from dawn to noon), being passed in a state of torpidity or slumber.

If disturbed at such times they drop hastily to the ground, offering little or no signs of life, and refusing to crawl or fly away when handled.

While clinging to the leaves in this passive sleepy condition many specimens are attacked by parasitic insect enemies in the shape of Tachinid flies, three species of which manage to affix eggs to their bodies or deposit tiny maggots on them, which quickly wriggling out of sight bore into the living tissues.

Being settled on the trees, fully exposed to all weathers, these beetles are naturally more or less affected by abnormal degrees of temperature. For example, on days when the maximum shade heat reaches 95 to 100 degrees Fahr., and the wind happens to be north-west, they soon exhibit signs of restlessness, and at length, becoming fully awakened, begin to crawl quickly about in search of cooler positions.

On such days the grey-backs in a large feeding tree will, as a last resource, often fly in a body to the shaded or sheltered side of the trunk and settle there side by side in mass formation.

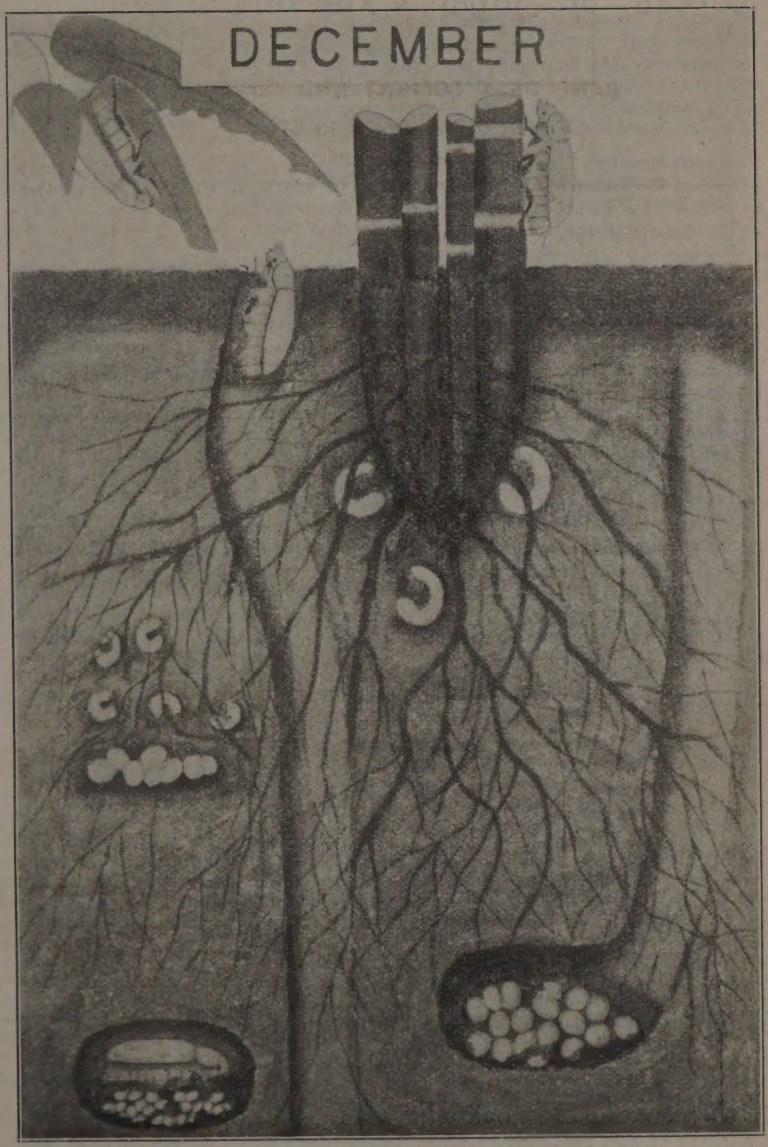

PLATE 168.
Habits of the "Greyback" Cockchafer Beetle during the month of December.

Duration of the usual evening flight is greatly influenced also by temperature, humidity, and illumination.

On warm dark nights following showery days these cockchafers become exceedingly active, often remaining on the wing several hours and being freely attracted to artificial lights. When no rain has fallen for a week, however, and the surface soil becomes very dry, they will often refuse to fly at all at the usual time (7.15 p.m.), or else take to wing for a few minutes only. Again, on moonlight nights, grey-backs are little in evidence, although should the atmosphere chance to be moist, and the sky more or less cloudy, migration may occasionally take place.

On such evenings I have watched the passage overhead of an extensive army of these beetles travelling westward, the members of which maintained a distance of 15 to 20 feet from the ground and 2 to 4 feet from each other.

The period of oviposition commences about a fortnight after emergence of beetles from the soil. Plantations are then invaded at night time by egg-laden females derived from food plants near at hand, which upon alighting on the ground against the base of a cane stool tunnel underneath it to the depth of a foot or more, and deposit their eggs in a roughly-formed ovate cavity or chamber measuring about 1¾ inch by 1 inch.

Each beetle is able to lay thirty-six eggs of a creamy-yellow colour, which just before hatching swell to nearly ¼ inch in diameter. About ten days after oviposition the tiny newly-hatched grubs make their appearance, and tunnelling upwards ultimately reach and take up their quarters amongst the fibrous feeding roots around the underground basal portions of the cane sticks.

These grubs of the first stage of growth can always be recognised at a glance by the width of head, which is ⅛ inch (never more or never less), remaining so throughout the period of the first instar, although, of course, the length of the entire grub may vary from ¼ to ⅝ inch, according to the number of days which may have elapsed since its first appearance.

METHODS OF CONTROLLING THE BEETLE AND EGG STAGES.

Collecting Cane Beetles.

The practice of this common-sense remedial measure is more or less followed by growers in Australia, and has been found, on the whole, to yield beneficial results.

Such appears to have been the case also in other parts of the world wherever the grubs of lamellicorn beetles figure as being important economic problems. Growers in the Cairns district used at one time to collect their grubs and beetles, and this work could, I think, still be followed up with advantage by individual cane farmers.

Full instructions, however, regarding this interesting question have been published by the Sugar Bureau from time to time in the "Queensland Agricultural Journal" and "The Australian Sugar Journal," a few references to which may, perhaps, be found useful to some of our growers:—"Queensland Agricultural Journal," Vol. XXXII., p. 575, and XXXIV., p. 486; "The Australian Sugar Journal," Vol. XXIII., p. 415, and XXII., p. 459.

NATURAL CONTROL BROUGHT ABOUT BY DROUGHT AND EXCESSIVE HEAT.

Control of this nature, resulting from the occurrence of adverse meteorological conditions at a time when these beetles are waiting to emerge from the ground, are doubtless of immense benefit to all concerned.

A check of this kind may at times destroy from 50 to 75 per cent. of all the grey-backs inhabiting an area embracing several hundred square miles of country.

During the year 1915, for instance, a dry spell lasting from July to November kept these cockchafers imprisoned in their pupal cells for nearly two months, causing hundreds of thousands which had transformed to the pupal state in September to perish helplessly.

Quantities of these dead beetles were ploughed up towards the end of November, and could be seen lying dead in the furrows.

The following additional methods of fighting the adult form of this cane pest should be mentioned here:—

1. Destruction of their feeding trees.
2. Capturing the beetles by means of light traps.
3. The use of soil deterrents against laying of the eggs.
4. Poisoning the leaves of their food plants.
5. More rigorous protection of our insectivorous birds.

Nos. 3, 4, and 5 are well worthy of closer study in the future, and considered from an economic standpoint present decided possibilities.

FACTS WHICH GROWERS SHOULD MEMORISE.

This being a beetle and egg month, an account of the grub condition of our grey-back will not be dealt with here, this being reserved for the period of January to March, when the activities manifested during such phase of its life-history will doubtless claim their usual share of attention from cane farmers. With regard to the winged form of this cockchafer, however, a note should be made of the dates on which grey-backs derived from the primary brood or from any succeeding emergences were first noticed on the wing in decided numbers. This point is very important, seeing that it is possible to determine from such dates later on the correct time for commencing fumigation work against the grubs with every likelihood of success.

A period of about seventy days should be allowed to elapse from laying of the eggs before starting fumigation of grub-infested soil. In seasons when there chances to be a secondary emergence of cane beetles, the above period would need to be extended to about 100 days in order to destroy the grubs from both emergences.

For fuller information on this point readers should refer to the "Queensland Agricultural Journal," Vol. XXXVIII., pp. 6 to 7, July, 1932.

The plate for this month shows grey-back beetles engaged in feeding on leaves, emerging from a pupal chamber (the track of its passage from same descending as indicated to a level below two egg chambers), and in the act of ovipositing. The eggs in one of these chambers are nearly ready to hatch, the female having—as indicated by tunnel—made its way again to the surface and flown off to feeding trees. Grubs of the first stage are shown just hatched from eggs, and others feeding on fibrous cane-roots near the surface.

THE RIGHT SPIRIT.

The story of a young teacher's success in educating the children of a "decadent" country district was told by the Tasmanian Director of Education (Mr. G. V. Brooks) at a Sydney Rotary Club luncheon. About five years ago, Mr. Brooks said, a young teacher was appointed to a school of fifty-seven pupils at the township of Springfield, Tasmania. The new teacher called a meeting of parents to discuss plans for cultivating four acres of swampy scrub land attached to the school. Not a single parent attended the meeting. The teacher appealed to the children to co-operate, and they and the teacher set about clearing and cultivating their plot of land. They obtained the money to begin work by selling £2 10s. worth of firewood to the Education Department. To-day there was £15 in the joint banking account of the teacher and the children, few of whom had ever had any money before. They had cleared and fenced the land, planted permanent pasture, and carried out many valuable experiments. Above all, they had learned the use of money and had gained qualities of citizenship. After some time the teacher advised the children to clear bracken-infested land on their parents' farms and plant potatoes. He offered to supply gratis the seed potatoes required, and was nonplussed when he discovered that so much land had been cleared by the children that £50 worth of seed would be needed. The Launceston Rotary Club offered to give the seed to the children, but, at a meeting of the pupils, a boy of twelve rose to his feet and moved that the offer be declined, and that the £50 be borrowed from the agricultural bank. An offer of free fertilizer by the Electrolytic Zinc Company was also declined by the pupils, who asked to be sold the fertilizer on twelve months' credit. On an average, the children gathered 9 tons to the acre, compared with the State average of 3 tons to the acre. During the depression not a child has gone from that school who has not gone to a job.

BANDED (SECTIONAL) CHLOROSIS.

ASSOCIATED WITH TANGLE TOP AND DEATH OF SUGAR-CANE.

By ARTHUR F. BELL, Pathologist.

DURING discussion in the session devoted to sugar-cane diseases at the initial conference of the International Society of Sugar-cane Technologists (Honolulu, August, 1924), reference was made to the occurrence of broad white bands upon the leaves of sugar-cane[2]. This form of chlorosis, which was termed sectional chlorosis, was reported by delegates as being present in Australia, Hawaii, and Continental United States. Mr. D. S. North stated that it was very common in New South Wales, and was there considered to be due to the combined influences of

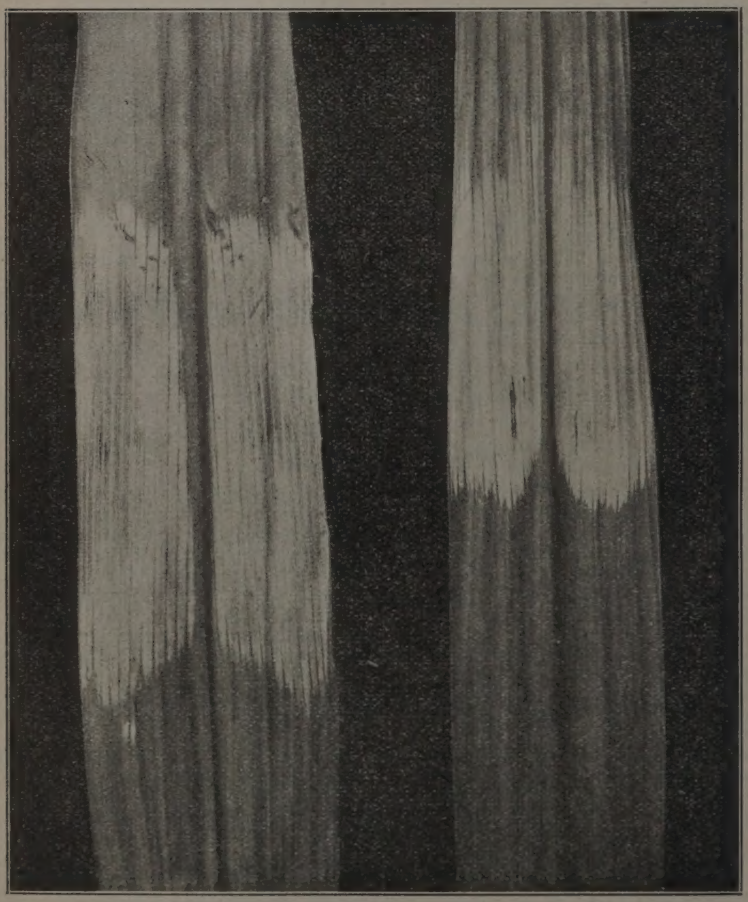

PLATE 169 (FIG. 1).
Typical white bands on leaves of the variety M. 1900 Sdg.

cold weather and the collection of water in the central cylinder of leaves. Dr. E. W. Brandes stated that the trouble had occurred in the greenhouses at Washington, D.C., which, he claimed, indicated that cold weather was not a necessary factor.

Description and Causation of White Bands.

The white bands (see Figs. 1 and 2) are typically 2 to 4 inches wide, irregular in horizontal outline, and range from marginal strips to bands which stretch across the whole leaf, the latter type being the more common. In rare cases only is the band uniformly white in colour, the midrib and larger veins remaining green as a rule. The injury to the tissue is permanent, and in no case does it regain the power of forming chlorophyll. The number of bands upon a single leaf varies from one to several (Fig. 2). The bands are progressively higher on the younger leaves, indicating that the injury took place in the leaf cornucopia and

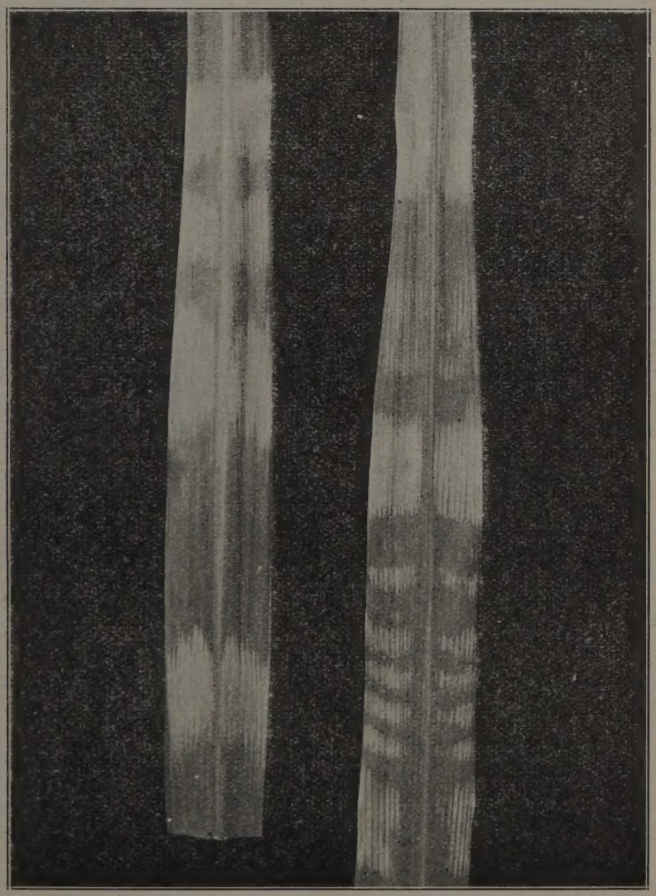

Plate 170 (Fig. 2).—Multiple bands on leaves of the variety D. 1135.

originally at the same level, but the greater growth rate of the young leaves carries the bands correspondingly higher. Upon dissecting the spindle of a recently injured shoot, it is found that the bands persist right through to the youngest leaves in the spindle.

The type of band is to some extent dependent upon the variety of cane. Those upon M. 1900 Seedling (Fig. 1) are uniformly broad and extend from margin to margin, while those upon leaves of D. 1135 (Fig. 2) are frequently very narrow. According to Faris[3], the colourless areas of certain varieties in Cuba are later attacked by fungi which cause the formation of reddish stripes with grey centres; the leaf tissue may split along these lines of weakness. As will be emphasised later, the feature is very pronounced in certain varieties in Australia.

Such colourless bands were artificially produced by Faris[3] in 1926. Inverted cones of strong paper were tied around the upper leaves of a number of canes and the cones kept filled with cracked ice on three consecutive nights; the typical bands appeared upon the leaves of the treated plants about one week later. The experiment was successfully repeated by Newcombe and Lee[5] in Hawaii in 1927.

Nomenclature.

Faris, in view of his experimental methods, applied the term "Cold Chlorosis" to this type of injury, but the term was not generally accepted owing to its occurrence in the greenhouses at Washington. Newcombe and Lee reverted to the original name of Sectional Chlorosis. In conversation with Mr. J. P. Martin, Pathologist to the H.S.P.A. Experiment Station, during his visit to this country in 1929, it was agreed that the term "Banded Chlorosis" would be more descriptive. Chloroses due to deficiencies of nitrogen, iron, and manganese, and sectional chimeras, are all "sectional," but no other form of banded chlorosis is known. Confusion with banded sclerotial disease is unlikely, as in this case the bands are multi-coloured and the disease is not widespread in the areas in which banded chlorosis is found. Moreover, banded sclerotial disease, in Australia at least, is found only during the uniformly warm, rainy season.

The Disease in Australia.

Banded chlorosis is extremely common throughout the winter months in New South Wales and Central and Southern Queensland, particularly in localities where the varieties M. 1900 Seedling and D. 1135 are grown extensively. The occurrence of several bands upon each leaf (Fig. 2) is quite frequent, and in the case of susceptible varieties a reduction of more than 50 per cent. in the green tissue of the leaf is common. Individual bands have been found to vary in width from one-fourth of an inch to seven inches. In the northern section of the Queensland sugar belt (latitude 17 S.) banded chlorosis is seen rather infrequently on Badila, which constitutes over 90 per cent. of the crop, but is common on the variety D. 1135, which is grown on the poorer soils. In Central and Southern Queensland it has been observed on every variety grown commercially, but in the case of Uba occurred only on the leaves of young suckers. The leaves of side shoots are affected as readily as are those of the main stem. Among the commercially-grown varieties which are severely affected are M. 189, Q. 813, B. 208, D. 1135, and M. 1900 Seedling, the latter being damaged to the greatest extent.

While this form of chlorosis is normally confined to the cooler months of the year, it is occasionally observed during the summer months. In December, 1926, towards the end of a six-months drought, Messrs. North and Dormer observed a field on the Richmond River in which the chlorosis was so bad that practically the whole of the effective leaf surface was destroyed. The cane was fifteen-months-old ratoons of an unknown variety; adjoining fields of Badila were also injured, but to a much less extent. The minimum temperatures recorded in this vicinity were:—November, lowest minimum 49 deg. F., highest minimum 66 deg. F., mean minimum 57 deg. F.; December, 51 deg. F., 78 deg. F., and 62·5 deg. F. No unduly high temperatures were registered during this period. In each case the fall to the minimum was relatively sudden;

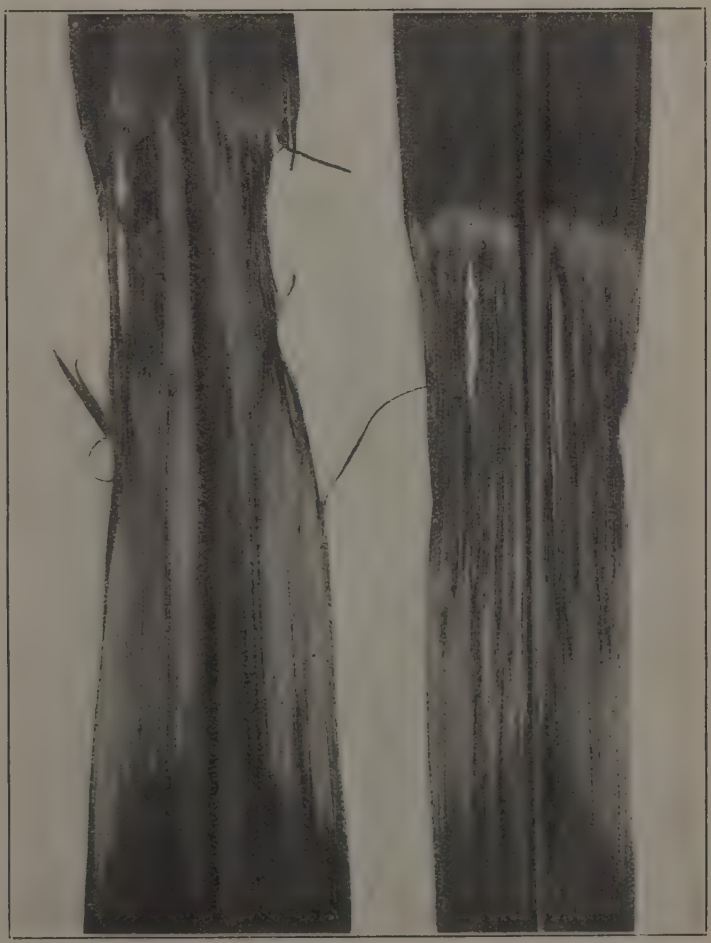

Plate 171 (Fig. 3).

Leaves of M. 1900 S. showing purple and black discoloration of bands and destruction of leaf tissues.

and the occurrence of the bands appears to depend on a relatively large sudden drop in temperature rather than on the absolute temperature.

Banded chlorosis may also be observed on a number of grasses, particularly on nut grass, *Cyperus rotundus*.

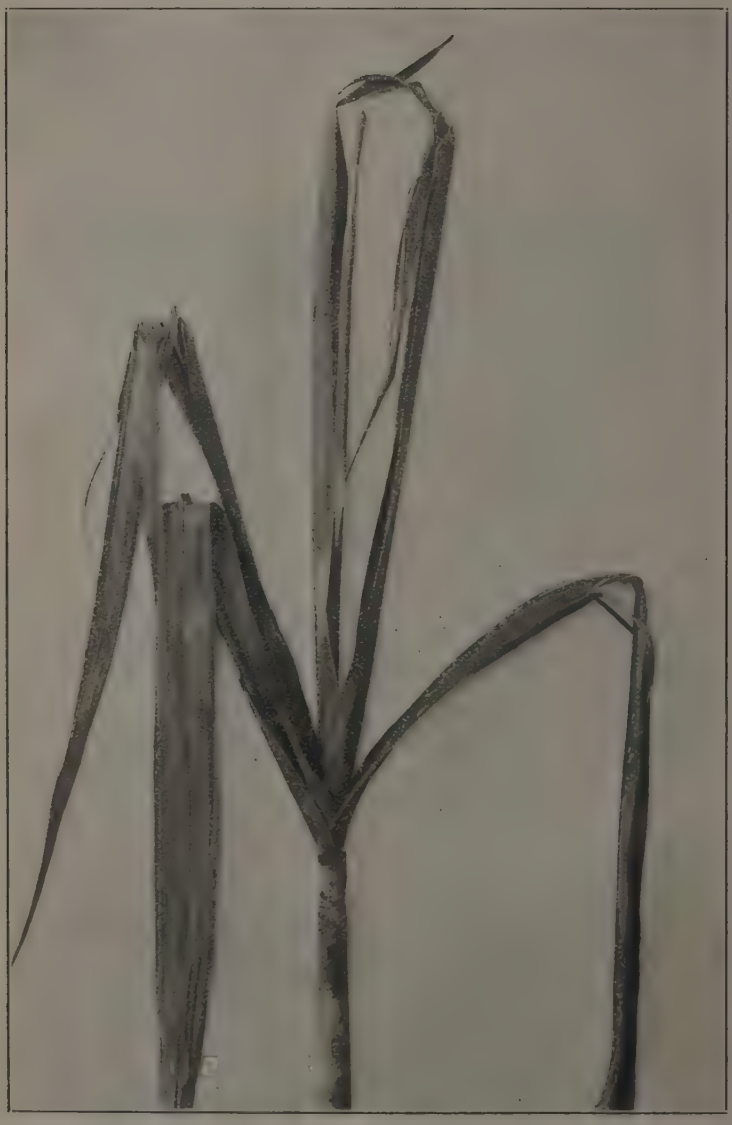

PLATE 172 (FIG. 4).

Collapsing leaves and incipient tangle-top due to the spindle of immature leaves having become caught in the shredded portion of one of the collapsing leaves of variety M. 1900 S.

With non-susceptible varieties of cane, the inhibition of the development of chlorophyll, with the resultant formation of white bands upon the leaves, marks the limit of the injury, but in the case of susceptible varieties the injury may be such as ultimately to kill the cane. The stages in the further progress of the disease in susceptible varieties are as follows:—In the course of a week or two the white bands become purple in colour; the change to purple commences at the base and may or may not extend over the whole band. At this stage the injured areas may be invaded by fungi, which rot the leaf tissue, causing the colour of the band to change from purple to black and then to ashy grey. In some varieties, however, the rotting of the tissues is not preceded by the purple discoloration. Finally the leaf becomes split and shredded (see Fig. 3). As a rule, the rotting of the tissue commences midway between midrib and margin, and proceeds rapidly. Throughout all the colour changes the bands retain a streaked appearance owing to the fact that the large veins tend to retain their normal colour. On one leaf there may frequently be seen five bands showing the five stages outlined above—viz., white, purple, black, ash-coloured, and shredded.

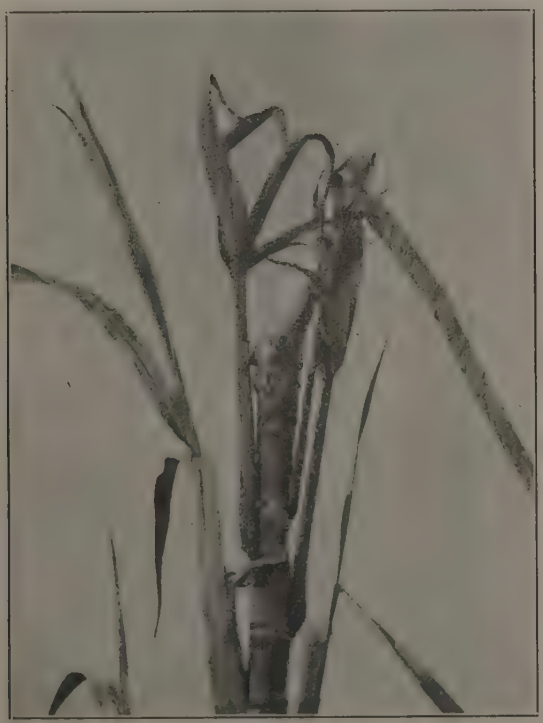

Plate 173 (Fig. 5).

Final stages of the disease. The growing point is dead and the leaf spindle twisted and rope-like. This has been followed by a profuse production of side shoots, two of which have in turn entered upon the tangle-top stage.

The death and shredding of the tissue cause the leaves to lose their rigidity and hang limply downwards from this point (Fig. 4). It frequently happens that a leaf, collapsing in this manner, becomes entangled about the spindle of immature leaves and prevents their free upward growth. The spindle becomes bent and twisted as the young leaves endeavour to break free, with the result that finally there occur many cases of tangle top as described by Lee[4] and Priode[6]. A case of incipient tangle top produced in this manner is shown in Fig. 4. In extreme cases the spindle of leaves becomes so matted and tangled that further upward growth is prevented, and the cane top dies (Fig. 5).

Plate 174 (Fig. 6).

Section of a dead top of 1900 S. showing the extraordinary twisting of the leaf spindle.

The death of the cane top is followed by a profuse production of side shoots, many of which also develop tangle top. A section of a dead cane top illustrating the tortuous twisting and malformation of the young leaves in the spindle is shown in Fig. 6. This stage is very similar to the "curly top" of Malabar seen on the Richmond River, New South Wales.

The winter of 1928 was comparatively severe, and cases of tangle top produced in this manner were very common throughout the central and southern portions of the State. The number of cases which were followed by the death of the cane were sporadic, with the exception of one field of mature plant 1900 Seedling in the Bundaberg district. The damage was particularly noticeable in the northern half of the field; here 25 per cent. of the canes had progressed to the tangle top stage, and of these approximately 30 per cent. were killed. Gumming disease was known to exist in this field, but in no case was there any evidence that this disease was directly responsible for the death of the cane. No gum oozed from any of the sticks in sweating, and in only one or two instances was there even a discoloration of the vascular bundles. There was a complete absence of the ladder-like lesions of pokkah boeng, as described by Bolle[1], or any other symptom of fungous attack. On the other hand, it is quite possible that the presence of gumming disease was a factor in bringing about the high mortality in this case.

As stated above, the effective leaf surface may frequently be reduced by more than 50 per cent., but as this reduction takes place mainly during the dry, cold months of the year, when growth is practically at a standstill, it is not considered that an appreciable loss in tonnage is experienced.

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Fig. 1.—Typical white bands on leaves of the variety M.1900 Seedling.

Fig. 2.—Multiple bands on leaves of the variety D.1135.

Fig. 3.—Leaves of M.1900 S. Purple and black discoloration of bands and destruction of leaf tissue.

Fig. 4.—Collapsing leaves and incipient tangle top due to the spindle of immature leaves having become caught in the shredded portion of one of the collapsing leaves. Variety M.1900 S.

Fig. 5.—Final stages of the disease. The growing point is dead and the leaf spindle twisted and rope-like. This has been followed by a profuse production of side shoots, two of which have developed tangle top.

Fig. 6.—Section of a dead top of M.1900 S. illustrating the extraordinary twisting of the leaf spindle.

RUST IN WHEAT.

By R. B. MORWOOD, M.Sc., Assistant Plant Pathologist.

THESE notes are intended to convey a brief popular account of rust which is almost invariably present in wheat crops and which at times practically ruins the crop. Rust is in the nature of a disease which is caused by a fungous parasite which lives within the leaves and stem of the plant. The "rust" observed consists of the brown spores of the fungus. These spores, known as *uredospores,* are produced in countless numbers and, blowing about in the wind, serve to carry the disease from plant to plant and from one paddock to another. If a spore alights on a healthy leaf or stalk in the presence of moisture, it germinates by sending out a long hair-like tube which penetrates the plant tissues and continues to grow inside them. This need for moisture on the surface of the leaf in which the spore is to germinate explains the occurrence of epidemics of rust only in damp weather.

After the spore has infected the leaf the first sign is a pale spot, which gradually enlarges and loses its green colour. After a few days the fungous threads which are ramifying inside the leaf come to the surface and produce a fruiting body, consisting of clusters of the uredospores just discussed.

Alternate Host.

In the latter stages of the disease black spores are produced on the stem. The black spore, known as a *teleutospore,* is a thick-walled resistant structure representing another stage in the life history of the fungus. It is of considerable scientific interest, and is very important in countries where barberry bushes exist, but of little practical significance in Australia. In England and other places the teleutospore stage remains dormant throughout the autumn and winter, then germinates to produce a third type of spore (*basidiospore*) which infects barberry leaves in the spring. Yet another type of spore is then produced on the barberry, and this latter, known as *æcidiospore,* serves for the initial infection of wheat crops. Thus, it is seen that two hosts are required for the continued existence of the rust fungus as it grows in spring on the barberry, in summer on wheat, and rests over winter as hard black spores. Once the epidemic is started it spreads through the wheat crop by means of the rust-coloured uredospores.

Oversummering of the Fungus.

In Australia the conditions are quite different, and considerable speculation has taken place as to how the fungus survives the intervening period between two crops. The problem is one of oversummering of the fungus, as the wheat crop, contrary to the conditions in older countries, is in an active growing state throughout the winter, and rust, though not abundant, can be found on careful search during this period. The uredospore is short-lived, and the teleutospore, which can survive long periods, cannot infect wheat save through the intermediate host, the barberry, and there is none of this bush of any consequence in Australia. Dr. Waterhouse, of the University of Sydney, has found that specimens of rust could be collected from stray wheat plants during every month of the year in all the important wheat-growing districts. He therefore came to the conclusion that it is carried over by the occurrence of the disease on these self-sown plants, which are found in protected situations

on headlands, &c., even in the best cultivated fallows. The general concensus of opinion is that there is no practical method of preventing this carryover from one season to the next.

Severity and Contributing Conditions.

The initial infection is then present, but rust is severe in certain seasons and not of any great consequence in others. This is largely due to the seasonal conditions, though, of course, the variety of wheat used has a big influence. Weather which is warm with abundant moisture in the atmosphere—such conditions as herald early summer storms—though the storms themselves may yield little rain—will aid the spread of rust. In a normal season rust is present when the wheat comes into ear, but only on the lower leaves, where it is sheltered from the drying action of the wind and sun. Given fairly dry weather during the ripening period, it will remain there doing no great harm. However, with a few still muggy nights and cloudy days or even showery weather, it will spread with remarkable rapidity up the stem and even on to the ear. If this occurs prior to the maturing of the grain the energy of the plant goes to feeding the fungus, and the grain suffers correspondingly, being reduced in quantity, light, and shrivelled. If the rust attack is early and severe, a promising crop may be rendered practically worthless. Late crops are, of course, particularly liable to rust, and any delay in the wheat due to the planting rains falling late, arrested development during a long hard winter, or frosting of the leading heads with consequent secondary development will tend to increase the severity of rust.

The losses are difficult to estimate, but the following figures give some idea as to their magnitude. In the United States in 1927, 60,000,000 bushels were lost through leaf and stem rust; in New South Wales the loss in 1903 was estimated at 3,000,000 bushels, and in 1916 at 5,000,000 bushels valued at over £2,000,000. No estimates of losses are available for Queensland, but it is generally recognised that they have been heavy. The last year of severe infestation was 1916, but in 1924 and in both 1930 and 1931 considerable reduction in yield occurred in many crops.

Physiologic Forms.

The rust fungi are a class of disease-producing organisms which affect a large variety of hosts, such as lucerne, peaches, and plums, roses, wattle trees, &c., but they are mainly diseases of the grasses and cereals. As a general rule, the different hosts are attacked by different species of rust, but a number of allied hosts may have the same species of rust. For example, stem rust of wheat is caused by a fungus known as *Puccinia graminis*, and the same fungus—or one that cannot be distinguished from it under the microscope—attacks also rye, barley, oats, and a number of grasses. However, it is found that spores from the fungus on wheat will infect only rye and barley, but not oats and the grasses. The strain on wheat, rye, and barley on the one hand, and that on oats on the other, and various strains on grasses, are known as different physiologic forms. The position is even more complex than this, for the strain on wheat consists of a large number of forms. These differ in their virulence and in the amount of resistance shown them by certain partially rust-resistant wheats. For example, Canberra wheat is resistant to Forms 43, 44, and 54, but susceptible to Forms 45, 46, and 55, while another wheat, Thew, is just the opposite, being resistant to 45, 46, and 55, but susceptible to 43, 44, and 54. It can readily be

understood that the presence of these physiologic forms complicates the problem of breeding wheats for rust resistance. Waterhouse has investigated the physiologic forms of rust in Australia, and has brought to light some remarkable facts. From 1921, when the investigations were commenced, up till 1925 six different forms were found, Form 43 being the most common. In 1925 another form not previously recorded (No. 34) was found in Western Australia. In 1926 it was also found in several localities in New South Wales and South Australia. By the following year it had invaded all the States, and was the most abundant form. By 1929 it so dominated the rust picture that no other form was found occurring naturally. Waterhouse also reports that after having bred a promising variety—Euston—resistant to all six forms of rust present prior to 1925, but which proved to be susceptible to the form appearing in that year, he has now a cross from Euston which is resistant to the new form as well. This crossbred, or rather series of selections from a crossbred, is still passing through the stage of breeding up and testing.

Leaf Rust.

In addition to stem rust on wheat there are also yellow rust and leaf rust, the former not being present in Australia. Leaf rust, as its name suggests, is practically confined to the leaves of the plant, usually only the lower leaves. It is not capable of such sudden severe onslaughts as is stem rust, which attacks both leaves and stalks, but it appears earlier in the season, and by a constant small drain on the vitality of the plant is probably responsible for a much greater loss than is generally realised. There are at least two physiologic forms of leaf rust in Australia, and any complete scheme for breeding rust-resistant wheat must take them into account.

Control Measures.

While appreciation of the cause of the disease and the conditions under which it develops is very desirable, the grower is most concerned with the possibility of controlling the trouble or to some extent reducing its intensity. Many diseases of fruit trees or valuable crops grown on a small acreage can be controlled by the application of protective sprays. Experimentalists in Canada have demonstrated that similarly wheat rust can be combated by dusting with sulphur several times during the critical period, but the cost of the materials and the difficulties of application prevent this method being regarded as a practical solution of the problem at present. Seed treatment is of no avail, and quarantine measures out of the question where the disease is already right throughout all the wheat-growing areas, and, as stated earlier, persists from season to season on stray seedlings which will grow in a few sheltered situations even with the best cultural practices.

The only available line of control lies in the use of resistant varieties. While the perfect resistant variety is not yet available, much has been done to relieve rust of its worst perils. Resistant varieties can be divided into two classes—the first, those that show a certain degree of true immunity to rust—i.e., those that will not be severely attacked however favourable the conditions; and the second, the early-maturing varieties which could be more correctly referred to as rust-escaping varieties. These latter will, if grown out of season, be just as liable to rust as any others, but will normally come quickly into ear and mature a crop before the onset of the warm stormy weather which allows the spread of a rust epidemic. Such varieties as Florence and Clarendon—two wheats bred

by William Farrer and Pusa—an Indian wheat, belong to this class. So also do a large number of the more recent crossbreds produced by Mr. Soutter at the State Farm at Roma. Among these mention might be made of Watchman, Novo, Beewar, and the Bobs Indian Pearl Manitoba crosses, known under the initials B.I.P.M. The objection to growing early varieties is that in an endeavour to escape "rusty" weather they may be brought into ear while there is still a danger from late frosts.

On the other hand, most of the varieties showing true resistance are of the small hard-grained low-yielding type not suitable for cultivation. The aim of the plant breeder is to combine the resistant qualities of these wheats with high-yielding capacity, good-quality grain, drought resistance, &c. Of the better type wheats bred locally Three C's appears to be the best rust resister to date. In the Southern States there are a few other wheats which appear to show a certain degree of true resistance. All these wheats, however, can suffer severely from the effects of rust under some circumstances. Mr. Soutter, the Department's wheat breeder, also has a few later crossbreds which are more promising. They are, however, not yet fully tested out nor bred up to the stage where they can be liberated, so nothing definite can be stated as yet. The same applies to a number of new wheats in the other States which have been favourably reported upon. It is hoped that from the continued efforts of the practical breeders there will shortly be evolved a number of wheats with a high degree of rust resistance, such that suitable ones may be chosen for each particular wheat-growing area.

GRAIN SORGHUM FOR PIGS.

Included among grain crops for pig-feeding purposes and specially recommended for districts where conditions are not as favourable to the growth of maize as is desirable, grain sorghums are worthy of trial.

Grain sorghums differ from sweet sorghums in being free from the sugary juices of the latter, in being more hardy, and in producing valuable grain crops. They differ from maize in being hardier, and in producing grain crops where maize fails to do so. They are usually shorter in growth; the grain is small, and is borne in dense compact bunches at the top of the stalk and not on cobs. They are not readily affected by hot winds when flowering—a frequent cause of bad cobbing in maize. They are also less affected by the presence of small amounts of salt in the soil. The grain is almost equal to maize in feeding value. It may be fed to all classes of stock, preferably after being crushed or cracked. It is fed to poultry after crushing, and is used with the morning mash in proportions up to 10 per cent.

In pig feeding it is also desirable to crush, soak, or cook the grain, otherwise a large percentage is wasted and best results are impossible. For roughage, the stalks may be harvested with heads intact when the grain is dry and hard, and in stacking the heads should be protected by being placed towards the centre of the stack. As required, the stalks are given to the pigs who make good use of the grain; though, as stated, a good deal of waste results in this system.

Milo meal may be purchased from some produce stores, and is generally valued at much the same price as pollard. Grain sorghums are grown mostly on the Darling Downs, but are suitable also for many other districts. Varieties of grain sorghums specially advised for Queensland conditions include: Red Kaffir, White African, and Fetenita.—E. J. Shelton, H.D.A., Senior Instructor in Pig Raising.

PESTS OF COTTON IN THE CALLIDE VALLEY.

By D. O. ATHERTON, B.Sc., Assistant to Entomologist.

THE weather conditions prevailing throughout the 1931-1932 season were abnormal in the sustained high temperatures and low rainfalls recorded. During the six months from October, 1931, to March, 1932, inclusive, the total rainfall at the Callide Cotton Research Farm amounted to little more than 7 inches, and of this only one effective fall—115 points—occurred in 1932. On many occasions the daily maximum shade temperature rose above 100 degrees F. and seldom fell below 90 degrees F. It is suspected that this unusual weather was in some way either partly or wholly responsible for the unusual insect population encountered in cotton. Of the Lepidoptera concerned in the economy of this crop five species caused appreciable losses, and of these the cotton leaf perforator (*Bucculatrix gossypii* Turn.), the rough boll worm (*Earias huegeli* Rogen.), the brown cutworm (*Euxoa radians* Guen.), the corn ear worm (*Heliothis obsoleta* F.), and the looper (*Antarchæa chionosticta* Turn.) are discussed in more or less detail in the following pages. The looper has not previously been recorded as a pest of Queensland cotton, and although specimens of the cotton leaf perforator were collected by Mr. A. A. Girault in 1923 from cotton it was evidently regarded as a pest of no importance. During the season under discussion, however, both these species, particularly the looper, occasioned losses on an extended scale. It was a late season owing to the comparative failure of the November rains in 1931, and very little cotton was planted before mid-December of that year.

The Cotton Leaf Perforator (Bucculatrix gossypii Turn.).

This tiny Tineid has not previously been regarded as a pest of cotton in Queensland, but during the season under discussion it accentuated the losses of some growers in the Callide Valley.

As is the case with all other species to be discussed presently, the larva is the stage which is destructive to the cotton plant. In this species it is a very small light-green caterpillar up to a quarter of an inch in length which destroys either the mesophyll alone or whole areas of the leaf attacked; in the latter case feeding generally takes place from the ventral surface of the leaf.

Nature of Injury.

The larva excavates small tortuous mines between the upper and lower epidermis of the leaves; these mines apparently follow no particular pattern, but are always tortuous, and may even form complete loops. The frass or excreta is deposited irregularly in the mine in tiny hard pellets. The mine, however, is not the most striking injury to the casual observer, "shotholes" in the leaves being generally more noticeable. The older leaves at the base of the plant are usually slightly more fleshy than those formed when the plant has grown higher, and are the first to be attacked. In mild infestations the activities of the larvæ may not extend beyond the few leaves near the ground, but in severe infestations fully-grown leaves on any part of the plant may be attacked, and in the worst cases observed the "shotholes" or feeding sites were so numerous and extended that most of the leaves of mature size presented a skeletonised appearance. This restriction in the area available for photosynthesis acted as a severe check on the growth of the plant.

Life History.

The egg has not yet been discovered, but it is very likely to be so small that detection by the naked eye is improbable. The larva, probably soon after emergence from the egg, eats its way through the epidermis of the leaf and commences feeding on the chlorophyll-bearing tissue between the upper and lower surfaces. It lives in this protected situation for some days, gradually forming a tortuous mine of ever-increasing width, which finally attains a length of about three-quarters of an inch. On the completion of the leaf-mining phase the larva, which is then about one-eighth of an inch in length, tears its way through the epidermis covering the larger end of the mine. Before feeding commences outside the mine a resting phase is passed under the shelter of a roughly circular, silky, yellowish structure built on the surface of the leaf. After emerging from this shelter the larva feeds on the leaf lamina, removing the small distinctive "shothole" areas, which are often about one-eighth of an inch across. The full-grown larva is about a quarter of an inch long, light-green in colour, and mottled with slightly lighter areas on the dorsal aspect of each abdominal segment. The pupa is formed in a yellowish silken cocoon, which is longitudinally ribbed and closely apressed to a sub-stratum of leaf surface, stem, or clod of soil. Prior to eclosion of the imago, the pupa makes its way partly out of the cocoon, and after this final ecdysis the pupal exuvium is left projecting from the old cocoon. The adult is a small inconspicuous grey moth about one-quarter of an inch long, and bears several darker spots along the axis of each forewing.

Importance of the Pest.

It is not anticipated that this species will be a pest in a normal season, but during the 1931-1932 season its depredations checked the growth on many cotton fields. In one instance, at Valentine Plains, plants which had almost ceased growing owing to the drought were practically defoliated.

The Brown Cutworm (Euxoa radians Guen.).

This comparatively well-known cutworm requires no further description here. During the season only one instance of damage to cotton was noted, and in this case about 1 or 1½ acres of very young cotton were destroyed on an area of land which had been very dirty with the weed *Tribulus terrestris* (Bull Head) while lying fallow. An investigation disclosed the brown cutworm in numbers on this area.

The Corn Ear Worm (Heliothis obsoleta F.).

This is another species which is too well-known to need much further description. Corn ear worm, tomato fruit worm, tobacco budworm, and American boll worm of cotton are some of the popular names by which it is known. The larval stage is chiefly remarkable for its voracious appetite and an astonishing colour range. Colours range from light-green to almost black, but lighter-coloured dorsal stripes running the length of the body are always discernible in the darker specimens. Some of the lighter-green specimens have been noted with cerise-coloured areas surrounding each abdominal spiracle. This colour range of the corn ear worm is well illustrated by Garman and Jewett.[1]

Nature of Injury.

Terminal growth buds, young foliage, squares, and bolls are all attacked, but the greatest losses are caused by its habit of excavating squares and bolls in all stages of development.

Seasonal History.

Late in December, 1931, the first eggs were discovered on young cotton—most of the fields had not been planted until the advent of the December rains which fell early in the month. By the end of January numbers of larvæ had emerged from the early eggs, and in one field a severe infestation was noted. On the Research Farm egg-laying reached a maximum in the first week of February, and the largest numbers of larvæ were present about one week later, and, especially in the maize, towards the end of that month. From this time onwards the activity of the corn ear worm decreased, and before the end of March had practically ceased. It must be emphasised that these terms are relative only; at no time during the season was the pest sufficiently numerous to cause any alarm.

Natural Enemies.

Several species of Tachinidæ are active parasites, and the predators include Sphecidæ and the Pentatomid *Œchalia consocialis* Bd.

Importance of the Pest.

This species has been regarded as the most serious insect pest of cotton in the Callide Valley for some years, but in the 1931-1932 season it caused very little loss.

The Rough Boll Worm (Earias huegeli Rogen.).

The rough boll worm, the common name given to *Earias huegeli*, is well known in Queensland and other cotton-growing countries, and detailed descriptions have been published by Ballard in 1927 [2] and others.

Nature of Injury.

The terminal growing shoot of the main stem is often destroyed, and this induces excessive vegetative development of the plant which is inimical to the production of a heavy crop. Squares and bolls of all sizes, from tiny squares one-eighth of an inch across to almost full-grown bolls, may be attacked. Damage to the bolls often results in the introduction of bacterial and fungal rots which cause an offensively odoriferous frothing to occur, and result in the destruction of the whole boll.

Seasonal History.

Terminal losses and the loss of tiny squares due to the rough boll worm were first noticed in January, 1932; after that month losses steadily increased until the end of March, and thenceforth remained more or less constant until the end of April, when observation was discontinued.

Natural Enemies.

These include at least two Tachinids, and possibly three (they have not yet been identified), a small Braconid, and *Œchalia consocialis*.

Importance of the Pest.

The rough boll worm has not previously been regarded as a serious menace to the Queensland cotton crop, but it has caused greater losses during the recent season than any other pest of cotton. In many cases the percentage of squares destroyed has amounted to 50 per cent. of the total number of squares formed by the plant, and in other instances the figure is still higher. From the data collected this season it is thought that either the rough boll worm has been overlooked to some extent in

the past, and losses caused by it attributed to the corn ear worm, or alternatively that the very droughty conditions in early 1932 have favoured the rough boll worm to the exclusion of other species of lepidopterous cotton pests.

The Looper (Antarchæa chionosticta Turn.).

This Noctuid insect, which has not previously been recorded as a pest of cotton in Queensland, made its appearance in numbers during the season. It is, of course, a pest in the larval stage, as is the case with the other species already discussed. The species has been described by Dr. A. J. Turner, and it is expected that the description will appear at an early date.

Nature of Injury.

The foliage is attacked by larvæ of all stages, the tiny young caterpillars concentrating on the leaf tissue between the veins of young leaves. Larger larvæ eat almost the whole of the leaf lamina, leaving only the larger veins, but it is only the succulent young growth which is destroyed, the harsh old foliage being avoided. When present in large numbers on a young succulent plant these loopers leave very few leaves intact, thus giving the plant a very bedraggled appearance. The indiscriminate feeding on succulent tissues often results in severe losses of terminal growing shoots, and many of the tiny squares clustered there. At times larger squares are attacked, but no instance of damage to bolls by loopers was noticed.

Life History.

The eggs may easily be mistaken for those of the corn ear worm when observed by the unaided eye, as they are similar in size and shape, and bear somewhat similar meridional ribbing. The top of the egg, however, is crowned with a circle of chorionic processes, and the colour is slightly greenish-blue in contrast to the pearly-white of corn ear worm eggs; these differences are distinctive when a lens is used.

The larva when full grown is one and a-quarter to one and a-half inches long, often green, with four dorsal black spots on each segment, and other black spots on the sides of each segment, and with two white latero-dorsal stripes running the length of the body. But the whole dorsal region may be darker, even nearly black, in colour with the latero-dorsal stripes widened to include the black spots. There may also be two or three additional white stripes on each side. When the larva is full grown it ceases to feed, shrinks slightly in length, and before pupating in the loose soil at the base of the plant changes colour to a decided reddish-pink. Pupation takes place at or just below the surface of the soil near the base of the plant. The larva spins a very flimsy silken cocoon, to which many soil particles become attached. The pupa is dark-brown in colour and one-half to five-eighths of an inch in length; some eight to twelve days are passed in this stage before the moth emerges.

The imago has a body about half an inch long and a wing expanse of approximately 1 inch. The forewings are stone to fawn coloured, sometimes with a greenish tinge, and bear two tiny white spots one-eighth of an inch apart along the axis of the median cell of each. The hindwings are dull creamy white with a shaded pinkish-brown area extending from the anal angle to the apex and bordered with a fringe of short white hairs.

Eggs are laid anywhere on the foliage or squares, but usually on the succulent leaves near the apices of vegetative branches.

The loopers are very active, and when disturbed are apt to escape by a sudden galvanic wriggle of the whole body which may throw them as far as 12 to 18 inches away from the scene of interference. Their efforts to escape when attacked and pierced by *Œchalia* are extremely violent, and in some cases both captor and captive are flung about for several minutes,,so convulsive are the spasmodic efforts of the looper to dislodge its enemy.

Seasonal History.

Looper caterpillars were present in all fields examined as early as the third week of December throughout the Callide Valley, and continued their onslaughts with undiminished vigour until March, despite the presence of many natural enemies. All stages in the life history of the pest could be taken throughout these three months, but the greatest numbers of both loopers and moths were to be found during February. After the early part of March few individuals were to be found, and it is thought that this sudden cessation of activity may be at least partly explained by the accumulated effect of natural enemies.

Importance of the Pest.

This pest is a severe check to the plant early in life, particularly in a season such as that under discussion, when the growth is not vigorous. Some squares are lost after they are well developed, but more losses of squares are due to the indiscriminate feeding on succulent growth near the main and branch terminals. Severely attacked fields presented a very ragged appearance as though they had been swept by a horde of army worms.

No control experiments were attempted, but it is likely that dusting with arsenicals such as calcium arsenate or lead arsenate would prove effective. Results from experiments with bait pails suggest that this may prove a promising avenue of investigation.

Natural Enemies.

Quite a number of insects are suspected of being useful in this role, and a number are known to be beneficial. The latter include *Ammophila suspiciosa* Sm. (Sphecidæ), *Chalcis ruskini* Gir., and *Chalcis rufifemur* Gir. (Chalcididæ), *Œchalia consocialis* Bd. (Pentatomidæ), and two or possibly three Tachinidæ (these are not yet identified).

Œchalia is a predator on all three serious lepidopterous pests mentioned in this paper, and would be a much more effective control were it not for the activities of the wasps *Telenomus* sp. and *Pachycrepis tectacorisi* Gir., which parasitise most of the eggs laid early in the season.

The Chalcids (*Chalcis ruskini* Gir. and *Chalcis rufifemur* Gir.) were probably a prominent factor in finally checking the looper in February and March, as out of ten pupæ collected in the field at this time seven were parasitised by these species.

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EXPERIMENTS IN THE TREATMENT OF STOMACH WORMS IN SHEEP.

By F. H. S. Roberts, M.Sc., Entomological Branch.

A SURVEY of the helminth parasites of sheep in Queensland extending over the past two years has indicated that parasitic gastro-enteritis is mainly due to infestation by the stomach worm, *Haemonchus contortus*. The nodule worm, *Oesophagostomum columbianum*, the lung worm, *Dictyocaulus filaria*, and the tapeworm, *Moniezia* sp., are the causes of occasional losses, but by no means rival *H. contortus* in their pathogenicity.

In portions of the Southern States parasitic gastro-enteritis is stated to be due mainly to the smaller *Trichostrongyles, Trichostrongylus sp., Ostertagia sp.*, and *Nematodirus filicollis*. These smaller nematodes are known from Queensland sheep, but as far as can be determined are of minor importance only.

The stomach worm, *Hæmonchus contortus*, was first reported in 1876, and even at that time was noted as causing heavy losses on the Darling Downs. At the present time the parasite is present over a good portion of the State, the area of infestation extending from the coast to the Warrego River in the South and to Jericho in the Central West. Generally speaking, the parasite may be said to be confined in its outbreaks to those areas in receipt of an average annual rainfal of about 20 inches or over. In districts with a lower rainfall any outbreak can usually be traced to animals which have been agisted on coastal country during dry times and brought back after rain.

PREVIOUS WORK IN AUSTRALIA.

The first recorded work in Australia in the treatment of parasitic nematode infestation in sheep is that of Henry. Arsenic, copper sulphate, and creosote were among the drenches used, and it was evident that the treated animals improved, but not to the same extent as those given improved feeding. Dodd (1908) recommended the use of copper sulphate and mustard, but no records are available as to any tests he may have carried out. Brown advocated arsenic and magnesium sulphate (epsom salts), which is still used to a large extent in Queensland at the present time. Whitehouse tested copper sulphate and copper sulphate and sodium arsenite, but did not obtain the same success as with his own formula, which consisted of arsenious acid, copper sulphate, and hydrochloric acid. Seddon and Ross conducted a large series of trials in 1927 in which numerous drugs were used. As a result, copper sulphate and mustard was regarded as being the most efficient remedy for *H. contortus*. High efficiencies were obtained from carbon tetrachloride, also. Ross, from experiments in Central Queensland, advises the use of carbon tetrachloride and mentions that copper sulphate also gave good results. Carew in 1929 conducted a series of tests in which arsenic and magnesium sulphate, copper sulphate and mustard, various mixtures of dichlorobenzol, carbontetrachloride, and a mixture of arsenic, copper sulphate and magnesium sulphate were employed. All except the dichlorobenzol mixtures proved satisfactory, with the arsenic, copper sulphate and epsom salts combination considered the most rapid in its action and the most efficient.

In the earlier experiments the efficiency of the drugs used was judged mainly by the improvement in the condition of the animals treated, occasionally aided by rough observations on the number of worms passed or on the number present on post mortem. The tests of Seddon and Ross, and most probably those of Ross, were, however, conducted on a different basis, and represent the first attempts in Australia to gain some idea of a drug's anthelmintic value by comparing the number of worms present before and after treatment, the efficiency being denoted in mathematical terms.

Anthelmintics Tested.

The principal anthelmintics in use against *H. contortus* in various parts of the world are (*a*) Carbon tetrachloride, (*b*) tetrachlorethylene, (*c*) copper sulphate, (*d*) copper sulphate and mustard, (*e*) arsenic and magnesium sulphate, (*f*) arsenic and copper sulphate.

Carbon tetrachloride is used in England and the United States, and is recommended in Australia by the Council for Scientific and Industrial Research. Copper sulphate alone is regarded as highly efficient in parts of the United States and in England, and is the Departmental drench in South Australia and West Australia. In New South Wales and Queensland copper sulphate in combination with mustard is used. Sodium arsenite and copper sulphate is the famous Veglia compound employed in South Africa. In Queensland Carew's copper sulphate, arsenious acid, and magnesium sulphate mixture is extensively applied. Arsenic and magnesium sulphate is still retained by many Queensland pastoralists as an efficient vermicide, and tetrachlorethylene has in the past few years come into prominence in the United States as an anthelmintic of reputed high efficiency.

In the choice of an anthelmintic several points must be kept in mind. The drug to be used must be safe, easily administered, inexpensive, and of high efficiency in one or two applications. The initial experimental work has, therefore, been to test under Queensland conditions the various drugs which have been accounted efficient elsewhere. In the present series of tests the anthelmintics used consisted of (*a*) carbon tetrachloride, (*b*) copper sulphate and mustard, (*c*) arsenic and magnesium sulphate, (*d*) tetrachlorethylene, and (*e*) sodium arsenite and copper sulphate. Copper sulphate was used in admixture with mustard as the combination has been in use in Queensland for some time and is, moreover, considered by Seddon and Ross to be more efficient against *H. contortus* than copper sulphate alone. Arsenic and magnesium sulphate was included as it had been favourably reported on by many pastoralists in various parts of the State. Of the arsenic and copper sulphate mixtures, that used in South Africa was selected in view of its reputed high efficiency in that country and also because of the contradictory results obtained by Seddon and Ross in New South Wales. In addition to these five drenches, sodium fluosilicate was included at the suggestion of Dr. I. Clunies Ross, Parasitologist to the Council for Scientific and Industrial Research.

Methods Used.

The most accurate method of determining the anthelmintic value of any drug is to treat a group of animals with the drug chosen, collect and count all worms passed over a number of days, and compare them

with the number of worms unaffected by the treatment and collected from the animals on post mortem. Unfortunately, this method is not a success with helminths infesting the stomach, as the dead worms become subjected to the process of digestion and only a small percentage of those killed may be passed. Hall and Foster, for example, using copper sulphate on three sheep, obtained 120, 240, and 314 *H. contortus* from the dung, a post mortem showing 0, 49, and 3 worms still present in the stomach, while two other untreated sheep from the same flock yielded 4,000 and 6,000 respectively.

The egg count method has been used by a number of workers whereby the efficiency of a drug may be computed by a comparison of the number of eggs per gram weight of fœces before and after treatment. As it is exceedingly difficult to distinguish the eggs of many of the sheep nematodes, the method is obviously useless where only one of these species is concerned. The respective larvæ, however, may be readily recognised and from fœcal cultures an indication of the anthelmintic value could be obtained. The method, however, is regarded as somewhat inaccurate and restricting when it is considered that the character and amount of fœces passed depends to such a large extent on the health of the animal and the nature of the food supplied, and that, moreover, only the female worms would be considered.

After due consideration it was decided to use the method employed by Seddon and Ross. By selecting a flock of sheep which had been running under identical conditions for some time prior to the experiments, retaining an adequate number of controls, and comparing on post mortem the average number of worms remaining in the treated and control animals, it is considered that the efficiency of the anthelmintics used can be computed to a fair degree of accuracy. Although it is recognised that parasitic infestation in animals of the same age and which have been running under similar conditions may vary within wide limits, the use of a sufficiently large number of animals, both for treatment and control, should obviate this variable infestation to a large extent. The adult sheep used in these tests consisted of three to five year old wethers, which had been running under the same conditions for the past three years. The lambs were mixed sexes about five months old which had been together since birth. As far as possible the number of animals retained for both treatment and control was five, but in some cases this number was not available. In view of the wide variation in the infestation of the adult controls, from 186 to 1,621, it was considered that more accurate interpretations would be obtained if the controls were increased from five to eight animals. The heavy infestation among the lambs resulted in such a weakened flock that some anxiety was experienced in giving the full lamb dose of each of the drugs. The lambs were also heavily infested with *Moniezia* sp.

Sodium fluosilicate was given in a hard capsule. The remaining animals to be treated were starved for up to 18 hours before and for four hours after treatment. Killing was commenced four and five days after treatment in the case of the adults and lambs respectively.

The fourth stomach was tied off, removed, and opened into a bucket of water. The ingesta was carefully washed off and the stomach, with the majority of the worms still attached, thoroughly washed in another bucket till all worms were removed. The contents of this

second bucket were then examined in a large flat glass dish. The ingesta was subjected to about three or four washings and decantations and examined in a similar manner. Lastly, the decanted fluid was searched for any worms which may have been poured off.

The anthelmintic efficiencies were computed by comparing as a percentage the average worms remaining per treated sheep with the average number per control.

The worms collected from the control sheep are given in Table No. 1.

TABLE No. 1.

CONTROLS.

No. of Sheep.	Class.	No. of *H. contortus* Present.
1	Adult	186
2	ditto	588
3	ditto	563
4	ditto	535
5	ditto	1,467
6	ditto	975
7	ditto	490
8	ditto	1,621
9	Lamb	3,624
10	ditto	2,646
11	ditto	2,978
12	ditto	2,886
13	ditto	4,241

Total worms, adults, 6,425; average worms per adult, 803.
Total worms, lambs, 16,375; average worms per lamb, 3,275.

EXPERIMENT No. 1.

Copper Sulphate and Mustard.

The use of copper sulphate as an anthelmintic against *H. contortus* was first developed by Hutcheon in South Africa. The doses ranged from ¾ oz. to three-month old lambs to 3½ oz. to sheep two years and older of a solution obtained by dissolving ·45 kgm. copper sulphate in 35·96 litres of water. In America Hall and Foster, using 50 c.cs. of a 1 per cent. solution (7½ grains) were successful in removing 98 per cent. of the worms from three lambs. Dodd recommended the addition of mustard, the adult dose being 17·5 grains of each. Seddon and Ross obtained better results against *H. contortus* with copper sulphate and mustard than with copper sulphate alone.

Wright, after a series of tests with mustard alone, claimed that it was ineffective against *H. contortus*. Against *Ostertagia* Seddon and Ross obtained an indication of an efficiency with a 36-grain dose to a lamb. Not much reliance, however, can be placed on this test, as only one animal was treated. From their results with copper sulphate it would certainly appear that mustard either possesses some anthelmintic value, or in some way or other its inclusion increases that of the copper sulphate.

In New South Wales the formula in use is 8 oz. copper sulphate and 8 oz. mustard to 6 gallons water. In Queensland the amount of water is reduced to 5 gallons, which raises the adult dose from 14·6 grains of each ingredient to 17·5 grains. In South Australia, Western Australia, the United States, and England, copper sulphate alone is still used, the respective adult doses being 14·6 grains in South Australia, 11 grains in Western Australia, 15·43 grains in the United States, and 17·5 grains in England.

The formula used in Queensland consists of 8 oz. copper sulphate and 8 oz. mustard to 5 gallons of water. The adult dose is 4 fluid oz., which contains 17·5 grains of each ingredient, the lamb dose 2 fluid oz., containing 8·75 grains of each. The results of treatment with this mixture are given in Table No. 2.

TABLE No. 2.

No. of Sheep.	Class.	Dose.	No. of *H. contortus* Remaining.
14	Adult	17·5 grains of copper sulphate and 17·5 grains of mustard	10
15	ditto ..	ditto	163
16	ditto ..	ditto	462
17	ditto ..	ditto	14
18	ditto ..	ditto	201
19	Lamb	8·75 grains of copper sulphate and 8·75 grains of mustard	214
20	ditto ..	ditto	315
21	ditto ..	ditto	1,265
22	ditto ..	ditto	652
23	ditto ..	ditto	278

Total worms remaining in adults, 850; average per adult treated, 170; average number worms per control adults, 803; efficiency therefore 79 per cent.

Total worms remaining in lambs, 2,724; average per lamb treated, 545; average number worms present per control lamb, 3,275; efficiency therefore 83 per cent.

Observations.—Copper sulphate and mustard in the doses administered showed a fairly high anthelmintic efficiency, removing on the average a larger number of worms from the lambs than from the adults. In the case of adults Nos. 14 and 17 it is noted that only 10 and 14 *H. contortus* were recovered on post mortem, indicating an efficiency approaching 99 per cent., assuming that they averaged the same number of parasites originally as the controls. Even when compared with control No. 1, which contained only 186 worms, the efficiency is still high—about 92 per cent. Three of the lambs yielded comparatively few worms, the other two 652 and 1,265 respectively. If No. 21 is omitted from the results the efficacy would, with the average worms of the remaining four sheep as 365, have been approximately 89 per cent. These results are somewhat in agreement with those of Seddon and Ross, who obtained removal percentages in starved lambs on a 7½-grain dose of 77 to 99, and also confirm their assertion that, whilst this drench will remove the majority of the worms from some animals, it will leave

a considerable proportion in others. It is difficult to compare the results given in this case by the 17·5-grain dose with those obtained in New South Wales by a 14·6-grain dose, but the comparison appears in favour of the larger dose.

EXPERIMENT No. 2.

Carbon Tetrachloride.

Hall and Shillinger found that doses of 12, 18, 24, and 48 c.cs. of carbon tetrachloride in 2 oz. castor oil removed all the *H. contortus* from the four lambs treated. A dose of 4 c.cs. proved 98 per cent. efficient, and indicated that this dose was too small to remove all the infestation. A 10-c.c. dose followed by 4 oz. magnesium sulphate was 100 per cent. efficient in three further sheep, a check animal showing 1,434 worms. Hall also notes that a 5-c.c. monthly dose to four animals removed all the worms from three sheep and left about fifty in the fourth. Montgomerie found a 1-c.c. dose to cause a large decrease in the egg count, whilst a 5-c.c. dose showed on autopsy to have removed all the *H. contortus*. Seddon and Ross found that 5-c.c. doses to two adults, and 2½ c.cs. to five lambs gave better results than any other drug tested. With a reduced adult dose of 2 c.cs. 76 per cent. of the worms were removed, though further tests with a 1-c.c. adult dose gave an efficacy of 81 per cent. The same dose to eight lambs removed 76 per cent. of the nematodes. Ross found that 2 c.cs. in 8 c.cs. of liquid paraffin gave the best results of the anthelmintics tested. The percentage efficiency is not stated. His recommendation was for an adult dose of 2 c.cs. and a lamb dose of 1 c.c. given in liquid paraffin to make a total dose of 5 c.cs. Carew tested this 5-c.c. mixture, and in one case found numerous *H. contortus* still alive twenty-four hours later. In another animal only a few worms were still present.

Five adult sheep were given 2 c.cs. of carbon tetrachloride in 3 c.cs. of liquid paraffin, and five lambs 1 c.c. of carbon tetrachloride in 4 c.cs. of liquid paraffin, in accordance with the recommendations of Ross. A further lot of three adult sheep were each given 5 c.cs. of carbon tetrachloride in order to observe the effect of the larger dose. The results obtained from the use of this drug are shown in Table No. 3.

TABLE No. 3.

No. of Sheep.	Class.	Dose.	No. of *H. contortus* Remaining.
24	Adult	2 c.cs. carbon tetrachloride in 3 c.cs. liquid paraffin	128
25	ditto ..	ditto	92
26	ditto ..	ditto	31
27	ditto ..	ditto	253
28	ditto ..	ditto	136
29	ditto ..	5 c.cs. carbon tetrachloride	20
30	ditto ..	ditto	4
31	ditto ..	ditto	nil
32	Lamb	1 c.c. carbon tetrachloride in 4 c.cs. liquid paraffin	71
33	ditto ..	ditto	29
34	ditto ..	ditto	324
35	ditto ..	ditto	210
36	ditto ..	ditto	834

Total worms remaining in adults given 2 c.cs. carbon tetrachloride, 640; average worms per treated adult, 128; average worms per control adult, 803; efficiency therefore 85 per cent.

Total worms remaining in adults given 5 c.cs. carbon tetrachloride, 24; average worms per treated adult, 8; average worms per control adult, 803; efficiency therefore 99 per cent.

Total worms remaining in lambs given 1 c.c. carbon tetrachloride, 1,468; average per lamb treated, 293; average worms per control lamb, 3,275; efficiency therefore 91 per cent.

Observations.—These results indicate that, whilst the 2-c.c. and 1-c.c. doses for adults and lambs gave relatively high efficiencies, 85 per cent. and 91 per cent., respectively, 5 c.cs. removed practically all the nematodes from the three sheep treated. Hall has shown that sheep will tolerate 1·3 c.cs. per kilogramme of body weight, the minimum lethal dose being about 2 c.cs. per kilogramme. Daubney, however, found that at a dose rate of ·1 c.c. to ·2 c.c. per lb. body weight, four out of nine sheep died, but with smaller doses up to 3 c.cs. no fatal symptoms followed. In New South Wales a 1-c.c. dose is in use against the liver fluke *Fasciola hepatica*, and occasional reports of the toxicity of this small dose have been made. On the other hand, 5 c.c. adult doses are in use in England and America, and are evidently regarded as safe, for otherwise they would have been reduced. In Queensland, moreover, the 2-c.c. dose is in regular employment in several districts, and no adverse reports of its safety have been received. Its recommendation by Ross must be regarded as another factor in favour of the opinion of the drug's safety.

It is felt, therefore, in view of the high efficiency and relative safety of the 2-c.c. dose, that it would be unwise to increase the dose to any extent.

The addition of a purgative to carbon tetrachloride has been found to decrease its toxicity without in any way impairing its anthelmintic value. Magnesium sulphate has been used for this purpose by Hall and Shillinger and Daubney, the latter being able to increase the amount of carbon tetrachloride to ·2 c.c. per lb. body weight without any toxic symptoms following. In Australia liquid paraffin has been in use as the accompanying purgative for some time, and it is thought that tests with this against other purgatives may be well worth considering.

EXPERIMENT No. 3.

Tetrachlorethylene.

Tetrachlorethylene owes its reputation as an anthelmintic for *H. contortus* to Schlingman, who was able to report the complete removal of all worms with 5-c.c. to 20-c.c. doses. Turner and Moon, using monthly doses of 1 c.c. for every 10 lb. of body weight found that after seven months *H. contortus* was still present in three of the four lambs treated. Seddon and Ross, using a 2½-c.c. dose, removed 70 per cent. of the infestation from five lambs, whilst a further test with this dose gave a removal percentage of 84. In 5-c.c. doses to adults there was an average of 62 residual worms, as compared with 394 in the controls, an efficiency of 85 per cent.

The adult dose of 5 c.cs. and the lamb dose of 2½ c.cs. which were administered are in accordance with the recommendations of Schlingman *et al.* The results obtained from these doses are given in Table No. 4.

TABLE No. 4.

No. of Sheep.	Class.	Dose.	No. of *H. contortus* Remaining.
37	Adult	5 c.cs. of tetrachlorethylene	482
38	ditto ..	ditto	364
39	ditto ..	ditto	220
40	ditto ..	ditto	410
41	ditto ..	ditto	48
42	Lamb	2½ c.cs. of tetrachlorethylene	Died
43	ditto ..	ditto	1,134
44	ditto ..	ditto	2,665
45	ditto ..	5 c.cs. of tetrachlorethylene	24
46	ditto ..	ditto	4

Total worms remaining in adults, 1,526; average per adult treated, 305; average worms per control sheep, 803; efficiency therefore 62 per cent.

Total worms remaining in two lambs given 2½ c.cs., 3,799; average per lamb, 1,899; average per control lamb, 3,275; efficiency therefore 42 per cent.

Total worms remaining in two lambs given 5 c.cs., 28; average per lamb, 14; average per control lamb, 3,275; efficiency therefore 99 per cent.

Observations.—The results of treatment with tetrachlorethylene are, in view of those obtained by other workers, very disappointing. With the five adult sheep evidence of a high efficiency is given in only one case, where 48 worms remained. The 2½-c.c. dose with the lambs gave an even more adverse indication of the value of this drug against *H. contortus*. The two lambs given 5 c.cs. yielded together only 28 worms, showing that at this dose rate for lambs a high efficiency may be expected. One of the lambs given a 2½-c.c. dose died. It was one of the weakest of the sheep treated, and expired about thirty hours after treatment. Tetrachlorethylene in 5 c.c. doses to lambs gave indications that this dose rate may be dangerous. The two lambs so treated evinced much distress after dosage, but recovered. Two other lambs, each given a 5-c.c. dose, collapsed five and ten minutes after treatment. Each of these animals was killed about fifteen minutes after administration of the drug, and on autopsy it was noticed that in each case the fourth stomach gave off the distinctive odour of the drug, and that the majority of the worms were either dead or stupified; at least, very few remained attached to the mucosa, the majority lying motionless among the stomach contents. These observations to a certain extent tend to confirm those of Taylor concerning the passage of fluids direct to the abomasum, and also indicate that tetrachlorethylene may act as a contact poison. It is pointed out that, in the case of these two lambs, the drug was administered very slowly, and that the collapse was not due in any way to the liquid entering the lungs.

EXPERIMENT No. 4.

Sodium Arsenite and Copper Sulphate.

Veglia, in a large series of experiments in which he endeavoured to ascertain the effect of repeated doses in obtaining a complete removal of all *H. contortus* present, found that a mixture of 125 mg. of sodium

arsenite (containing 80 per cent. arsenious acid) and 500 mg. of copper sulphate given to adult sheep on two successive occasions most nearly achieved his purpose. Even a single treatment removed a big percentage of the worms present. Sheather, in England, found that this dose caused a considerable decrease in the number of eggs passed. Whitehouse reported that the South African remedy was less effective than his own formula, which consisted of an adult dose of 10 c.cs. of a solution containing 60 grains arsenious acid, 180 grains copper sulphate, 12 c.cs. hydrochloric acid, and 8 oz. water. Seddon and Ross gave 2 grains sodium arsenite and 8 grains copper sulphate as a powder to four lambs and two adults, but their results indicated that the mixture even at these strengths possessed little if any anthelmintic efficiency. Sodium arsenite alone in 60 mg. doses to lambs gave an efficiency similar to that obtained with tetrachlorethylene. The Whitehouse mixture was given to two sheep only, which on autopsy showed 31 and 42 *H. contortus* as against an average of 166 in the controls. Carew, using a 2-oz. adult dose of a solution of 8 oz. copper sulphate, 2 oz. arsenious acid, and 5½ lb. magnesium sulphate to 5 gallons of water, reported that all the worms in the fourth stomach were killed in twenty-four hours. The lamb dose of this formula, 1 oz., was regarded as rather severe, and the amount of copper sulphate was therefore reduced to 4 oz. Wood notes that the addition of sodium arsenite did not tend in any way to give better results than copper sulphate alone.

In this experiment adult sheep were given 2 grains of sodium arsenite (85 per cent. arsenious acid) and 7¾ grains of copper sulphate The lambs in accordance with their age were given ¾ grain of sodium arsenite and 3 grains of copper sulphate. In each case the drugs were administered as liquids, the results being given in Table No. 5.

TABLE No. 5.

No. of Sheep.	Class.	Dose.	No. of *H. contortus* Remaining.
47	Adult	2 grains sodium arsenite and 7¾ grains copper sulphate	94
48	ditto ..	ditto	89
49	ditto ..	ditto	296
50	ditto ..	ditto	8
51	ditto ..	ditto	42
52	Lamb	¾ grain sodium arsenite and 3 grains copper sulphate	3,266
53	ditto ..	ditto	228
54	ditto ..	ditto	331
55	ditto ..	ditto	621
56	ditto ..	ditto	924

Total worms remaining in adults, 529; average worms per adult, 106; average worms per control adult, 803; efficiency therefore 87 per cent.

Total worms remaining in lambs, 5,370; average worms per lamb, 1,074; average worms per control lamb, 3,275; efficiency therefore 67 per cent.

Observations.—In the case of the five adult sheep sodium arsenite and copper sulphate in a 2 and 7¾-grain dose, respectively, gave a higher and more uniform efficiency than any other anthelmintic tested, though

the margin between it and carbon tetrachloride is comparatively small. In four out of the five sheep less than 100 worms remained, in one case only 8 being collected, the efficiency throughout being noted as 87 per cent. With the lambs, however, the reduced dose removed only 67 per cent. of the nematodes, due mainly to the large number, 3,266, collected from No. 52. As the controls averaged 3,275 worms there is no indication of any efficiency at all in this case. In the other four the mixture gave an efficiency of 84 per cent. The only explanation that can be offered for No. 52, in view of the high efficiencies evidenced by the remaining animals, is that the dose could not have been swallowed and was vomited soon after administration. Unfortunately, no other lambs were available for a repeat test, but, in consideration of the results obtained otherwise, sodium arsenite and copper sulphate has given evidence of a high efficiency, but requires further investigation before any definite recommendation can be made.

EXPERIMENT No. 5.

Arsenic and Magnesium Sulphate.

Arsenic and epsom salts was one of the first anthelmintics used in Australia, and owes its prominence in Queensland to Brown. Brown has frequently written of the efficiency of this mixture, but no controlled tests have, so far as is known, ever been made of its value against *H. contortus*. Seddon and Ross used sodium arsenite in their experiments in 1927, but not arsenic and epsom salts. Carew mentions it as an efficient drench as a result of his trials in 1929, no worms alive or dead being found in the fourth stomach forty-eight hours after treatment. The arsenic is stipulated by Brown to contain not less than 95 per cent. arsenious acid. The epsom salts have probably been included in order that the purgative action may prevent much of the absorption of the arsenic, so reducing its toxicity.

The formula recommended by Brown consists of 2 oz. arsenic, containing not less than 95 per cent. arsenious acid, and 6 lb. magnesium sulphate to 5 gallons water. The adult dose is 2 fluid oz., or 2⅓ grains of arsenic and 105 grains of magnesium sulphate, the lamb dose 1 fluid oz. In Table No. 6 will be found the results of treatment with these doses.

TABLE No. 6.

No. of Sheep.	Class.	Dose.	No. of *H. contortus* Remaining.
57	Adult	2⅓ grains arsenic and 105 grains magnesium sulphate	214
58	ditto ..	ditto	6
59	ditto ..	ditto	26
60	ditto ..	ditto	410
61	ditto ..	ditto	84
62	Lamb	1⅛ grains arsenic and 53 grains magnesium sulphate	452
63	ditto ..	ditto	686
64	ditto ..	ditto	746
65	ditto ..	ditto	516
66	ditto ..	ditto	613

Total worms remaining in adults, 740; average per adult, 148; average worms per control adult, 803; efficiency therefore 82 per cent.

Total worms remaining in lambs, 3,013; average per lamb, 603; average worms per control lamb, 3,275; efficiency therefore, 87 per cent.

Observations.—These results demonstrate that Brown's reports of the efficiency of this drench were apparently well founded, with both adults and lambs a large percentage of the worms being removed. The results are more uniform with the lambs, due most likely to a more even original infestation. The worms remaining in four of the five adult sheep denote an efficiency of 88 per cent., and from three of the four only 6, 26, and 84 *H. contortus* were collected.

EXPERIMENT No. 6.

Sodium Fluosilicate.

Sodium fluosilicate has been given recent prominence as a dust spray for insect pests, but the literature available gives no information concerning its anthelmintic properties. Rizk Attia in Egypt gives the minimum lethal dose for goats as 1·5 grams, and states that even a 1 gram dose may be followed by toxic symptoms. Ross, in the course of correspondence with the writer, notes that the toxicity of the drug is not as high as reported and states that the dose for sheep is 1 to 1·5 grams and that 3 grams may be toxic. Unfortunately only four sheep were available for testing this drug, all of which showed the typical signs of a heavy infestation. Nos. 68 and 69 were very weak and it was very doubtful whether they would survive. The dosages varied from 1 to 2 grams, the drug being administered in a hard capsule after the usual preliminary starving.

TABLE No. 7.

No. of Sheep.	Class.	Dose.	No. of *H. contortus* Remaining.
67	Adult	2 grams	Died
68	ditto ..	1·5 grams	Died
69	ditto ..	1·5 grams	220
70	ditto ..	1 gram	1,594

The animal that received two grams and No. 68 to which 1·5 grams were given died the day following treatment. Unfortunately it could not be determined to what extent the drug had aided in bringing on death. The fact that No. 69 was able to tolerate the 1·5 gram dose, even though it was very weak before treatment, indicates that the 1·5 gram dose should not affect a normal healthy animal. As only 220 worms were collected from this sheep as compared with an average of 803 from the controls, there is an indication that with this dose sodium fluosilicate possesses some degree of anthelmintic efficiency. The large number of worms remaining in No. 70 after administration of a 1 gram dose likewise suggests that this dose is too low to be of any value.

Discussion.

Summarising the results of the experiments outlined above, the efficiencies of the anthelmintics used are expressed below.

TABLE No. 8.

Drug Used.	Efficiency in Lambs.	No. of Animals Used.	Efficiency in Adults.	No. of Animals Used.
	Per cent.		Per cent.	
Carbon tetrachloride (2 c.cs.)	..	..	85	5
Carbon tetrachloride (1 c.c.)	91	5	..	..
Carbon tetrachloride (5 c.cs.)	..	..	99	3
Arsenic and magnesium sulphate ..	87	5	82	5
Copper sulphate and mustard ..	83	5	79	5
Sodium arsenite and copper sulphate	67	5	87	5
Tetrachlorethylene (5 c.cs.)	99	2	62	5
Tetrachlorethylene (2½ c.cs.)	42	3	..	..
Sodium fluosilicate (2 grams) ..	..	..	Died	1
Sodium fluosilicate (1·5 grams) ..	..	..	73	1
Sodium fluosilicate (1·5 grams) ..	..	..	Died	1
Sodium fluosilicate (1 gram)	..	..	*	1

* 1,594 *H. contortus* left ; 803 in controls.

Perhaps the most outstanding finding in these experiments has been the almost total failure of tetrachlorethylene to repeat the high efficiencies obtained from it by previous workers in the doses of 5 c.cs. and 2½ c.cs. for adults and lambs respectively. In both classes of sheep, with the exception of sodium fluosilicate, this drug left the largest number of worms of the several drugs tested. No definite opinion of the anthelmintic value of sodium fluosilicate can be expressed until further experiments are carried out. In view of the high efficiencies of three of the drugs used and of the fact that sodium fluosilicate, if proven highly efficient, would most probably have to be administered as a powder, a tedious process where large numbers of sheep are concerned, it is doubtful whether additional work with this drug would be worth while. Carbon tetrachloride, copper sulphate and mustard, and arsenic and epsom salts all gave very good results. Carbon tetrachloride in 2 c.c. doses was second in efficiency in the adults, though the margin between it and sodium arsenite and copper sulphate was comparatively small. With the lambs it removed on the average 91 per cent. of the worms present and proved to be the most efficient drug tested on these animals. For reasons already outlined, although the 5 c.c. dose gave almost 100 per cent. efficacy with three adult sheep, this dose is not recommended. It is, therefore, considered that, in so far as efficiency is concerned, carbon tetrachloride in 2 c.c. and 1 c.c. doses for adults and lambs respectively was the best anthelmintic tested. Second preference may be given to arsenic and magnesium sulphate, though there is little to choose between this mixture and copper sulphate and mustard. It is felt that the results given by sodium arsenite and copper sulphate would be equal to, if not better than, those yielded by arsenic and magnesium sulphate or copper sulphate and mustard, but in view of the comparatively low efficiency exhibited by the reduced dose for lambs, it cannot, at any rate for the time being, be given any recommendation.

Taking into consideration the factor of safety, there has been a certain prejudice against the use of carbon tetrachloride, but in a 2 c.c. adult dose it is considered that this drug is equally as safe as any of the others tested. It must be borne in mind that the safety of any drug depends to a large extent on the method of administration, and the methods of many sheepmen who endeavour to race through the flock result in a certain carelessness, under which conditions even the safest drug may produce fatal results. The extensive use of carbon tetrachloride on many large properties in Queensland, without any conspicuous untoward results and its recommendation by Ross, are considered adequate guarantees that the drug is safe. In calcium deficient country, however, proper precautionary measures must be taken, and the flock should be given a calcium lick for some time prior to treatment.

Copper sulphate and mustard in the doses administered, 17·5 grains, appears reasonably safe, but it must be pointed out that in New South Wales the safe dose is placed at 14·6 grains.

With regard to ease of administration carbon tetrachloride is without doubt the easiest to handle. Compared with the preparation of arsenic and magnesium sulphate and of copper sulphate and mustard, little mixing is required for carbon tetrachloride and liquid paraffin. Against the tedious funnel method of administration carbon tetrachloride is given in a syringe holding the exact dose, and under these conditions the number of sheep treated can be almost doubled. Finally, carbon tetrachloride may be given without any previous starvation, a decided advantage when the animals are weakened by dry conditions, when the starvation required before and after treatment by the other drugs must seriously affect the flock.

Finally, considering the cost of treatment, it is noted that at Brisbane prices, to drench 1,000 adult sheep, the cost of carbon tetrachloride and liquid paraffin would be about 11s. 3d., of arsenic and epsom salts 8s., and of copper sulphate and mustard 10s. 6d. Carbon tetrachloride is therefore the most expensive of the three anthelmintics tested, but costs very little more per 1,000 sheep than copper sulphate and mustard. This slight extra cost is thought to be more than compensated for by the time saved in mixing and in administration, and by its greater efficiency.

Summary.

Under the conditions outlined above carbon tetrachloride in a 2 c.c. adult and 1 c.c. lamb dose combined with liquid paraffin to make 5 c.cs. is considered the most successful method of treatment against *H. contortus*. Arsenic and epsom salts, and copper sulphate and mustard in the doses used are also highly efficient, with little to choose between them but with the former drench perhaps the cheaper and more efficient. Tetrachlorethylene gave very disappointing results. In any case its cost as compared with that quoted for carbon tetrachloride, &c., would prohibit its use, the treatment of 1,000 sheep costing a little more than 22s. Further experiments are required with sodium arsenite and copper sulphate and with sodium fluosilicate before any definite opinion on their efficiency against *H. contortus* can be expressed.

The Efficiency of Carbon Tetrachloride, Tetrachlorethylene, &c., against Tapeworms.

As the lambs were heavily infested with the tapeworm, *Moniezia* sp., an opportunity was afforded of making some observations on the effect of the various anthelmintics used on these parasites.

The five control lambs yielded nearly fifty tapeworms between them, many of the worms being over 10 feet in length. From the presence of tapes in each one of the five controls it was assumed that each lamb of the flock was infested. Carbon tetrachloride, tetrachlorethylene, and copper sulphate and mustard appeared to have had little effect on the tapes in the lambs treated, every lamb yielding numbers of worms, many of them of fair length. From the lambs treated with arsenic and magnesium sulphate not one complete tape, i.e., a tape of any noticeable length, was obtained. Unfortunately time did not allow a more complete examination to ascertain whether or no the heads were removed along with the strobila. However, the results indicate a certain efficiency against tapeworms possessed by this arsenic mixture. With sodium arsenite and copper sulphate there was evidence of a slight efficiency only.

Acknowledgments.

Thanks are due to Mr. J. D. Allen, Spring Meadows, Dalby, for making the adult sheep available and for allowing facilities on his property for carrying out certain of the experiments; to Mr. W. F. Alexander, Pipewell, Dalby, who so kindly supplied the lambs; to Mr. C. J. Pound, late Government Bacteriologist, for permitting certain of the experiments to be carried out at Yeerongpilly; and to Mr. Robert Veitch, Chief Entomologist, without whose approval and sympathy this work could not have been undertaken.

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Everything possible is done to ensure delivery of the Journal, and new subscribers would help us greatly by observing the simple rule suggested, and thus reduce the risk of error in names and postal addresses to a minimum.

PACKING GRAPES FOR MARKET AT HOME AND ABROAD.

By J. H. GREGORY, Instructor in Fruit Packing.

THE grape industry of Queensland, particularly in the Stanthorpe district, is increasing in production rapidly. To meet this increase it is necessary to find new markets. Tests in cold stores have shown that the Stanthorpe grapes are eminently suited for export overseas. Successful shipments have been sent to Batavia, Singapore, Canada, and New Zealand. The success gained has only been achieved by close attention to the packing and the "get up" of the fruit. I propose, as two distinct systems of packing are used, to deal with the handling of grapes separately for the local and export markets. The same care and system of harvesting the fruit should be used either for export or local market.

Shed Equipment.

The equipment necessary in the packing shed is not of a very costly nature. One set of small platform scales, long benches for laying out the grapes ready to pack, packing stands to hold the case whilst being packed, grape trimmers, case-making bench, wiring machine, 1 large bin for holding bulk cork, kero tins cut flat for cork measuring. The benches and stands can be made at home for a small cost. Empty galvanised iron crates with the addition of legs make satisfactory benches.

Harvesting.

Fruit should be picked, as far as possible, in the cool of the day and never whilst wet from rain or dew. Pickers can, with advantage whilst picking, trim the bunches of all small, damaged, or diseased berries, care being taken to keep the fruit as cool as possible whilst handling. Large, roomy baskets make excellent picking containers. The bunches when trimmed should be carefully placed in the

PLATE 175 (Fig. 1).

Showing the method of placing all stalks up in the picking basket so that bunches can always be handled by the stalks without having to touch the fruit. This assists in preserving the natural bloom on the fruit.

picking baskets with the stems up (Fig. 1), pickers taking care to always handle the fruit by the stems and to as much as possible retain the natural bloom on the fruit. The baskets when full should be placed in a cool, shady position until ready for transport to the packing shed. On entering the packing shed the bunches

should be examined further and any damaged berries missed during previous handling carefully clipped. The fruit should then be spread out on a flat table on the cool side of the building (Fig. 2), again taking care to place them carefully with the stalks up. This assists the fruit to cool and enables the packer quickly to select any particular size or type of bunch that he may need to fill a particular portion of the layer when he is packing the fruit.

Plate 176 (Fig. 2).

Fruit spread out on the table prior to packing. Again notice the way all stalks are placed upwards to permit easy handling of bunches.

Sweating or Wilting.

It is recommended to sweat grapes for about 24 to 48 hours before packing. This is done by storing the fruit in a cool place where the air has free circulation around it. Weather conditions have an effect on the sweating period, grapes in warm weather taking less time than in the cooler periods. After sweating the fruit becomes tougher and more pliable, enabling it to be handled with greater ease and less chance of cracking the berries or damaging the fruit at the stalk. Sweating also helps to eliminate slackness in packing which is likely to develop during transit through the shrinkage in berries which are packed without being sweated.

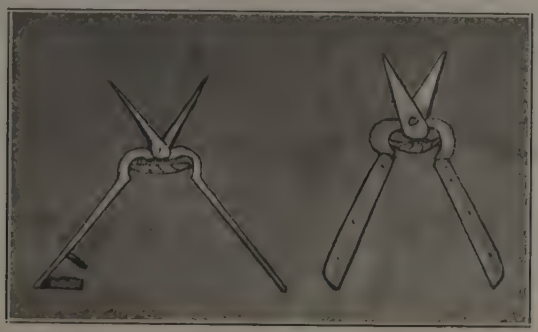


Plate 177 (Fig. 3).

Types of grape trimming clippers.

PACKING FOR LOCAL MARKET.

Containers.

There are two types of half-bushel cases in use and a quarter-bushel case. Bushel cases are not recommended. The Dump Half-bushel, 18 inches long by 7⅛ inches wide by 8⅝ inches deep, is an excellent container, but the better container is the Half-bushel Standard Case, 18 inches long by 5¼ inches wide by 11¾ inches deep. This container when in transit has not the same weight of fruit pressing on the bottom layer as the Half-bushel Dump case, the "Standard" only having 5¼ inches of fruit as against 7⅛ inches in the "Dump." This is a factor for consideration where fruit is being sent long distances to the northern markets of the State. A quarter-bushel case is also used and is very popular on some markets. Growers are advised to consult with their distributors before adopting this package. Another popular method adopted by progressive growers is the use of cartons. (Fig. 4.) Some growers use cardboard but the best type of carton is one made of plywood. This has the advantage of not bulging at the sides when filled with fruit, as happens on occasions with cardboard, making it harder to place the containers in the boxes used for transit. The cartons can be made to a size that will hold approximately 2 or 4 lb. of fruit and will fit the ordinary cases in use. Different sizes of cartons can be used, but growers are advised to consult distributors as to the best sizes to use for their particular trade.

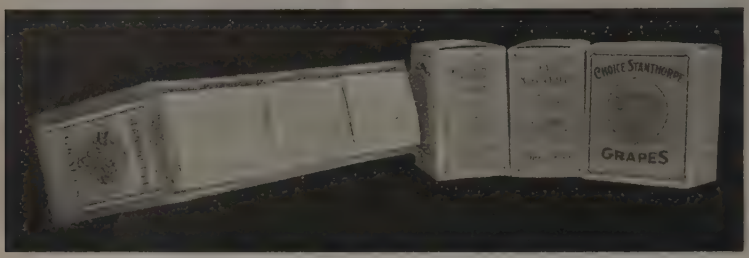


PLATE 178 (Fig. 4).
Cartons used for packing. Three of these cartons fit ¼-bushel case.

Packing.

The same system of packing is adopted in both the types of cases. Packers should endeavour as much as possible to keep all stalks to the centre of the box so that buyers can open the cases on either top, bottom, or sides and only find a surface of fruit with practically no stalks showing. (Figs. 5, 6, and 7.) This style of packing is easily done. The case should be lined with clean white or coloured paper and the fruit carefully placed in the case in layers. The first layer is started by placing the points of two bunches in the corners of one end of the box with the stalks to the centre of the layer but facing upwards and inwards. (Fig. 5.) Bunches are then placed point first into the corners made by these bunches and the side of the box until the layer is finished. The space, if any, between the two lines of grapes of the first layer is then filled by placing bunches into the space with the points to the bottom and the stalks up. This

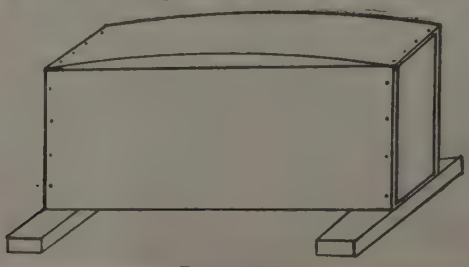
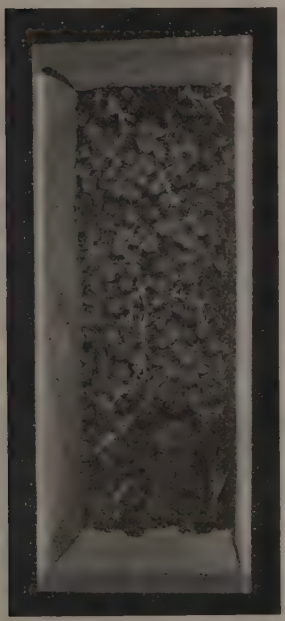


PLATE 179.
Method of placing two pieces of timber on the floor of shed. This makes a good solid nailing down bench, and permits the bottom of the case as well as the top to bulge slightly when the lid is nailed on.



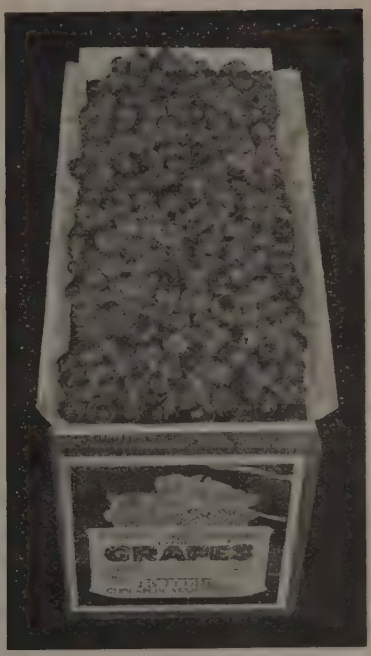


PLATE 180.

FIG. 5.

Method of placing the first layer. Note how all stalks are placed inwards and upwards so that only fruit will show if the bottom board of the packed case is removed.

FIG. 6.

Finished case before nailing down. Note how all stalks are carefully hidden. If care is taken, all sides of the case will open up showing fruit only.

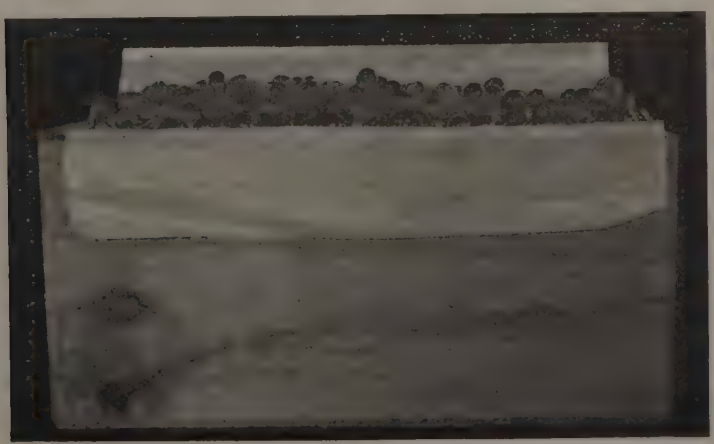


PLATE 181 (Fig. 7).

Side view of case before being nailed down. Note the height of the fruit in the case.

presents a level surface of fruit free from stalks to the bottom of the case. The process is carried on until with the Dump Case the case is half filled, when the fruit is shaken into position by light bumping. Battens should be placed beneath the ends of the case whilst this operation is being performed. The Standard case should have the fruit eased into position when about one-third full and again when about three-quarters full. The case is finally finished by packing the fruit in layer by layer, bringing the fruit to a height of 1 to 1¾ inches (Fig. 7) above the top of the case. Battens are then placed under the ends of the case, the paper folded over, the lid held in position with a gentle pressure placed on the fruit, and the case be packed in the case. This is an advantage from the buyer's point of view. It sufficient care is taken in this operation the bunches will not be injured in any way. After easing the fruit into position and before finally nailing down, the lid should be removed and the top of the case inspected. If by misehance any grapes are cracked these should be carefully clipped and removed. The whole success of grape packing is having the fruit tight in the case to prevent movement whilst in transit. Movement in the finished case causes damaged and wet fruit, making consignments wasty and unsaleable.

Packing for Export.

Where grapes are intended to be stored for lengthy periods or transported over long distances in refrigeration, two methods of packing are used, these being granulated cork and sulphite paper and woodwool.

The most favoured method commercially is the use of granulated cork as the packing medium. This method of packing has the advantage over the sulphite tissue paper and woodwool, in the fact that a much larger quantity of fruit can be packed in the case. This is an advantage from the buyer's point of view. It also means that the grower does not need such a large number of cases to harvest his crop, greatly reducing his outlay for timber handling and cartage. Shipping freights, which are based on the cubic space occupied, are reduced, as a greater quantity of fruit is contained in a given space. It must be remembered that overseas buyers buy the fruit on the basis of the weight contained in the case.

In some countries barrels are used instead of cases and sawdust in place of granulated cork. It is necessary that the sawdust be absolutely clean and free from taint.

All varieties of grapes grown in Queensland are not suited for export, the number of suitable varieties being very small. The best varieties of white grapes in their order of merit are the Ohanez, Waltham Cross, and Cervant; black grapes, Purple Cornilhon, Black Malaga, and Black Muscat; red grapes, Red Malaga and Flame Tokay. This opinion is based on the results of export consignments to the East, New Zealand, and Canada, and experimental packages stored in Brisbane.

After analysing the results of these consignments the length of time the various varieties should be able to be stored with safety would be—Black Muscats, four to five weeks; Waltham Cross, five to six weeks; Ohanez, Purple Cornichon, Flame Tokay, Red Malaga, Black Malaga, and Cervant, seven to eight weeks.

It must be stressed that this could only be achieved by every attention to careful handling.

Selection of Fruit.

Careful selection of bunches also plays an important part in successful exporting. Large loose types of bunches should always be selected. Tight bunches are unsatisfactory, being harder to trim and clean, berries in many cases being damaged whilst trimming is being carried out. Often the large, tight bunches contain many blemished berries in the centre of the bunch which can only be satisfactorily removed by cutting the bunches into sections. This is undesirable as the value of the fruit is depreciated by reducing the size of the bunches. Bunches should be selected containing only large even fruit the "hen and chickens" type of bunch being unsuitable. Bunches consisting of small fruit are of low commercial value and have no chance of returning to the grower sufficient to pay marketing and transport expenses over a long distance. It is advisable to leave a length of the stalk attached to the bunch when picking. This assists the packer when handling the fruit. Bunches with long stalks appear to carry and open in better condition than when clipped short.

Containers.

The container used, when packing with cork, is the three-quarter bushel with a centre partition. The dimensions of this case clear of the partition when made on the flat are:—24 inches long by 11¾ inches wide by 6 inches deep. Packing

can be done from the side with the case made on the flat or, as some packers prefer, the case can be made the upright way 24 inches long by 6 inches wide by 11¾ inches deep.

Both ways have been tried and proved satisfactory, the advantage of the wide way allowing more room for working. Bunches being placed in the bottom of a case made the narrow way have a much greater chance of being damaged whilst being placed in position through rubbing against the side of the box owing to the working space being so confined.

This case is quite satisfactory for the sulphite paper and woodwool packing. A smaller case is not recommended commercially, although satisfactory results were obtained with the standard half bushel case 18 inches long by 11½ inches wide by 5¼ inches deep.

Lining Paper.

Lining paper is used with all the different packs. Plain white or coloured paper cut to the correct size to fit the case should be used. For the ¾ bushel paper 12 inches by 20 inches wide is suitable and leaves a good margin for overlapping, two pieces being used for each compartment of the case. Care should be taken to see that the paper is placed in the case neatly as damaged or torn lining paper creates a bad first impression when fruit is being examined.

Granulated Cork Filler.

The cork comes packed in bales ready for use, but pressed into a tight mass. This can easily be broken up by the use of an old chisel used with a stabbing motion. The bulk cork should be placed in a bin, as if left open the wind will soon blow it about the packing shed, causing waste and extra work and loss of time in clearing up.

A kerosene tin cut on the flat is a good cork measure for the packer to use, permitting the packer to see the amount of granulated cork he is using. The average case of fruit takes approximately 1½ kerosene tins of cork to the case. This will vary slightly whether the cork is fine or coarse, or the bunches tight or loose.

No weight of cork can be given to use to the case as the different types of cork vary in weight, some being 4½ lb. to the kerosene tin, whilst some cork weighs as low as 2½ lb. to the kerosene tin.

The cork should not be too coarse as it will not penetrate the bunches. Care should also be taken to see that the cork is not too finely granulated, as cork of this description adheres strongly to the fruit after storage, spoiling the selling value. It should be remembered that after travelling long distances and being stored a long time bunches cannot be shaken too roughly to dislodge cork, as the berries are not as tight on the stalk then as when picked. This shows the necessity of the cork being free from dust and not ground too finely.

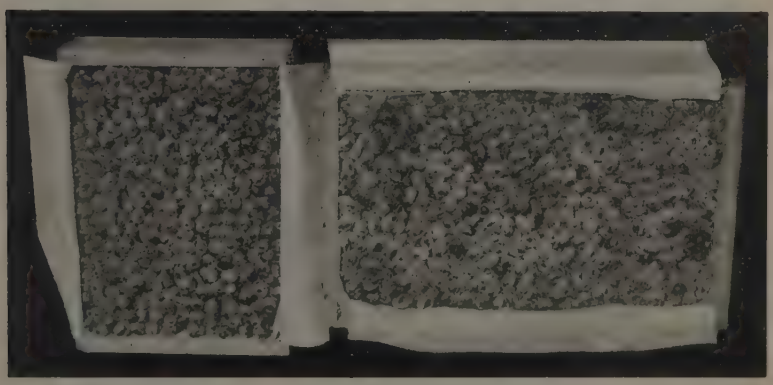


Plate 182 (Fig. 8).
Standard ½-bushel and ¼-bushel case opened on the side showing the absence of stalks when the fruit is packed correctly.

Packing.

When packing on the flat, the case is first lined with paper, and a layer of cork about ¼ inch in depth is spread on the bottom of the case. The trimmed bunches are then placed in a layer upon the cork. This layer when completed has a layer of cork sprinkled upon it, and the process is repeated until the case is filled (Fig. 9) to ½ inch above the top. The fruit and cork is then gently shaken into position by placing the lid over the fruit and gently knocking each end upon the bench. If this operation is carefully carried out no damage to the berries will result. If any berries happen to become damaged they should be carefully clipped off and removed.

A layer of cork is then spread on the fruit (Fig. 10) and the lid applied.

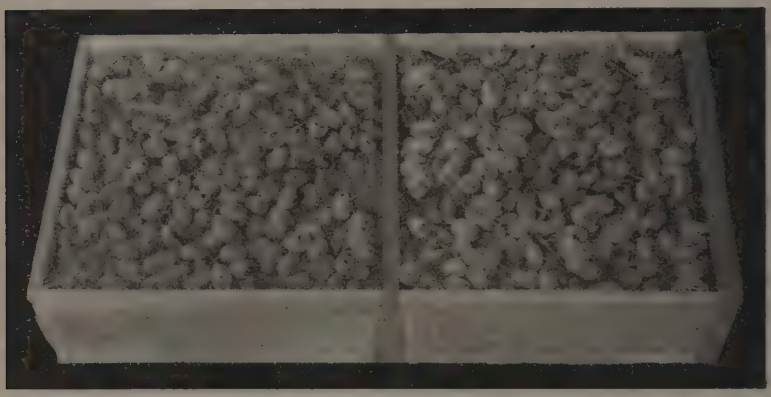


PLATE 183 (Fig. 9).
Case packed for export in granulated cork. Before nailing down the fruit is covered with a final layer of cork.

If packing the narrow way, a depth of about ½ inch of cork should be spread on the bottom, then a layer of fruit, which is covered with cork, taking care to see that the cork runs between the fruit and the side of the case. This process is repeated layer by layer until the case is full. Whilst packing, the fruit and cork should be gently shaken in position when the case is about one-third full, and again when about 3 inches from the top. The case should be filled to ½ to 1 inch above

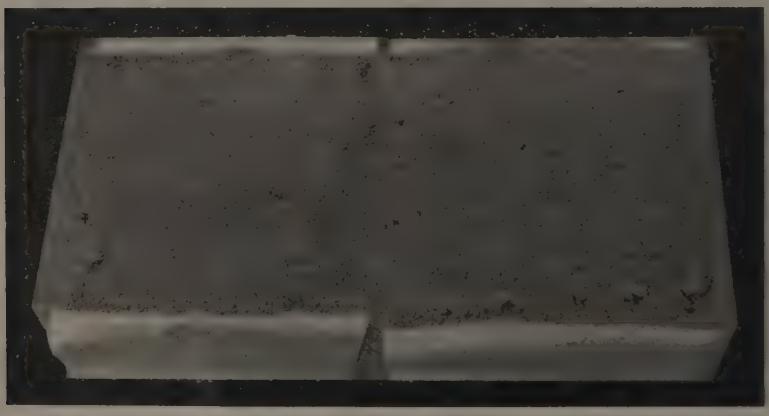


PLATE 184 (Fig. 10).
The same case as in Fig. 9 with the final layer of cork applied. This case is now ready to nail down.

the top. The fruit should then be shaken into position by using the lid in the same manner as in the other packs. Granulated cork should be used to level the top off before finally nailing the lid in position.

Packing in woodwool and sulphite paper should present no difficulties. The case is first lined with paper, and then a pad of woodwool is placed on the bottom and around the sides of the box. The clipped bunches are then carefully wrapped in the sulphite paper and placed closely together in the box. Only large-sized bunches should be used. Where bunches are small, two at a time can be placed in the one sheet of paper. This is preferable to wrapping small bunches separately. The packer should aim at having one layer of fruit in the case. From this it will be seen that only large bunches will adapt themselves satisfactorily to this pack. When the box is filled any spaces between the bunches are carefully padded with woodwool (Fig. 11). A layer of woodwool is then placed on the top of the fruit, and the lid placed in position. The sulphite paper should be cut at least 15 inches by 15 inches in size.

Special points to remember when doing this pack are—

Tease the woodwool into a soft pad.

Keep the bunches tightly packed and well padded so that there is no movement in the fruit after the lid is applied.

Close attention to the following points when packing grapes will assist greatly in obtaining satisfactory results:—

1. Clip bunches of all blemished, diseased, and small berries. Remember the export trade only wants very high-class fruit.
2. Always remove damaged or diseased berries by clipping. Pulling often causes moisture with its high percentage of waste.
3. Do not pick grapes after heavy dews or rain, but wait until the fruit has dried. Bunches do not readily dry after removing from the vine. Moisture is fatal to the successful carriage of grapes.
4. Avoid cutting up bunches as much as possible; small bunches or sprigs of berries spoil the sale of high-class grapes.
5. Sweat in a cool, dry place.
6. Do not pack fruit whilst hot, but allow all fruit to thoroughly cool before packing.
7. Handle fruit by the stalks only. This helps to preserve the bloom on the grapes, helping them to keep a fresh appearance even after a long period of storage.
8. See that all boards fit closely together when making up cases.

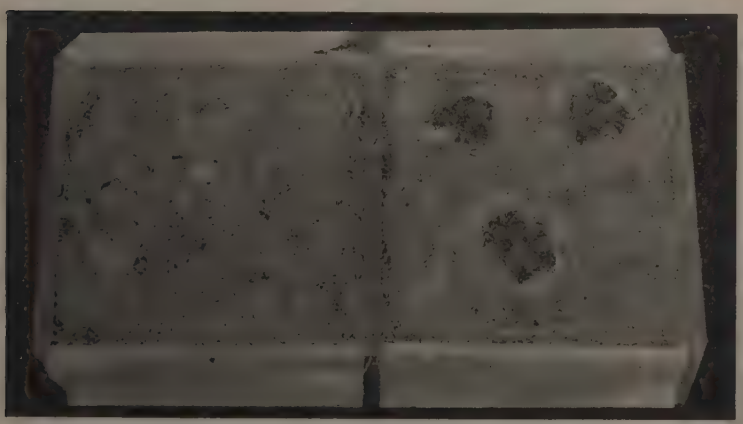
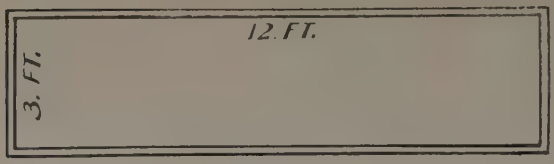
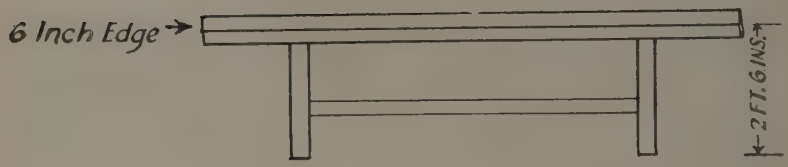


Plate 185 (Fig. 11).

Fruit packed for export using the sulphite paper and woodwool method of packing. The paper on three of the wrapped bunches is torn, showing the fruit.



PLAN



ELEVATION

Plate 186 (Fig. 12).
Table to hold fruit whilst packing.

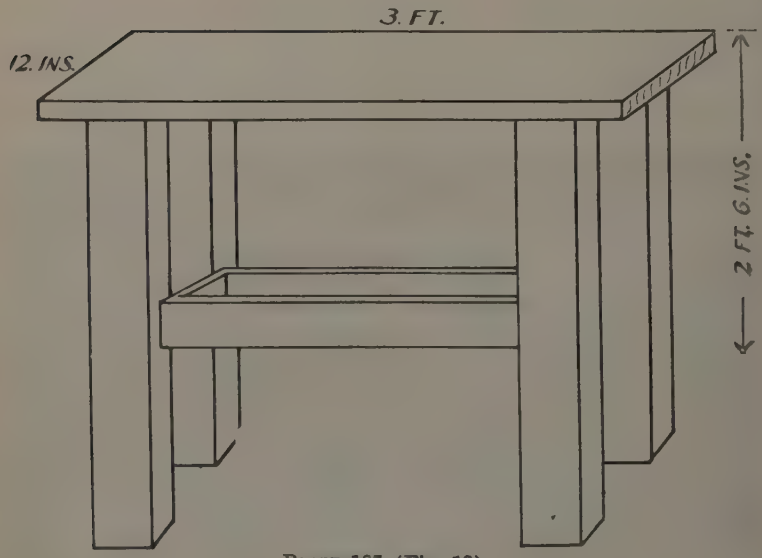


Plate 187 (Fig. 13).
Packing Stand.
This stand will hold one export case and the kerosene tin cork container whilst packing.

Labelling.

The use of a fancy label is of great assistance from the display and advertising point of view. Labels should be made bright and attractive, and contain in the design spaces to permit the printing of all particulars such as the weight and variety of grapes. The label to be complete should have embodied in the design the grower's name and address, the address having to contain the word "Australia" in plain letters to be suitable under the Commerce Act for export. A label 11 inches by 5½ inches will fit the end of the export case or standard half-bushel. The dump half-bushel label will measure a maximum size of 8 inches by 7 inches.

Stencils.

Stencils must also conform to the Commonwealth regulations and Queensland Fruit and Vegetables Act by having the full name and address of packer, and where used for export the word "Australia." Cases must also be branded with the name of the fruit and the weight contained in the case.

Wiring.

Wiring the cases when exporting or sending long distances is a necessity. The wires should be placed around the case ⅛ inch from the inside edge of the ends. Two wires should be used, one at each end in preference to one around the middle of the box. Care should be taken to see that they are placed around the case parallel to the end of the box towards the middle about ⅛ to ¼ inch from the inside edge of the end boards.

This is essential if the wiring is to give the best results. Often when packing for local markets two small boxes can be wired together to advantage.

Transport.

It is necessary to follow up good harvesting and packing operations by careful handling whilst the fruit is in transit to the rail or boat. The fruit should not be left where it can become wet. Carters should not walk on or sit upon packed cases. It is only by the close attention to all these details that the perfect product can be delivered to the world's markets in a condition that is good enough for the buyer to pay enough to give the grower a satisfactory return for his labour.

Acknowledgment.

Thanks are due to Messrs. J. Ferris and J. Winkler, of Glen Aplin, and R. Perkins, of Ballandean, for making available the fruit which was used for taking the illustrations.

BACON FOR EXPORT.

"After seeing what has been achieved in other lands, we in Australia should pause and consider the advisability of having a stocktaking of our methods, with the object of making a sincere effort to produce a suitable bacon for export at a selling price not above world parity," writes Mr. J. T. Madden, of Casino.

"Australia is at a disadvantage in competing in the British market owing to its geographical position," he continues. "The possibility of securing an oversea trade of mild-cured bacon hinges on the result of research that is now being conducted with the object of overcoming the difficulty of transport through the tropics. Mild-cured bacon cannot satisfactorily be transported over long distances, as so far no simple way has been found of preventing the fat turning rancid after about six to eight weeks' storage. The alternative is to make bacon from frozen pork, and scientific experiments in progress at the Low Temperature Research Station at Cambridge under the Department of Scientific and Industrial Research have lately proved that frozen pork that has been stored for a longer period than would be necessary to send it to Great Britain from Australia can still be made into very good bacon.

"The bacon produced is as good as Dutch and very little inferior to Danish."

Mr. Madden directs attention to the fact that in 1929-1930 production of pig products was short of State requirements. "If the official year book figures can be taken as correct," says Mr. Madden, "there appears to be ample scope for increased production in New South Wales to supply our own requirements."

WILD LUCERNE.

(*Stylosanthes mucronata*).

G. B. BROOKS, Director of Agriculture.

IN view of the numerous inquiries being made regarding this interesting leguminous plant, the following notes appertaining to its distribution and habit of growth may be of interest.

Stylosanthes mucronata (Wild Lucerne), a native of tropical America, appeared in the Townsville district many years ago, the writer noting it on the outskirts of the city as far back as 1912. It is now widely distributed along the coastal areas, being in evidence from Cooktown to St. Lawrence.

When grown under favourable conditions, it has a close resemblance to ordinary lucerne. In habit of growth, however, it is more recumbent and spreading, forming a dense green mat when closely grazed down.

A Summer Annual.

Stylosanthes is a summer-growing annual, appearing in early spring and lasting well into the winter. This is a feature of considerable importance as, unlike most winter-growing legumes, its appearance every season is assured. From observations made in the Mackay district it would appear that its period of seeding is during late summer. This late-maturing habit may, in all probability, be a handicap to its self-propagation in the more temperate districts owing to the season being too short for seed production.

The angular-shaped seed is smaller than that of ordinary lucerne and has a tough bristle attachment about ⅛ inch in length with a characteristic hook at the end. These hooks project from a fan-shaped container, a unique proviso for distribution in that they readily attach themselves to the hairs on the legs of stock, &c. It is likely, however, that the main source of distribution is through stock grazing on the plant when it is in the seeding stage, a heavy germination usually eventuating from the manure

Its first appearance in a district is invariably in a railway station yard as a result of stock having fed on the plant prior to trucking and the dung getting kicked out during train delays and shunting. Straying stock grazing in the yard then distribute the plant along the roads.

Wild lucerne prefers a soil with a firm bottom for its establishment, and rarely shows up in deep loams where vegetation such as tall grass is in evidence. Those who desire to give this useful pasture plant a try-out will therefore obtain best results by sowing on a comparatively hard seed-bed and mulching with a little farmyard manure.

The Departmental stocks of seed are exhausted, but supplies may be obtained from Mr. F. G. Harris, care of Michelmore and Company, Proprietary, Limited, Post Office Box 37, Mackay.

Feeding Value.

In regard to the feeding qualities of Wild Lucerne, the following analyses show that it compares very favourably with the ordinary variety:—

ANALYSES OF WATER-FREE MATERIAL.

—	Cairns, 1929.	Townsville 1928.	Townsville, 1917.	Townsville, 1914.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Protein	12·4	14·6	12·3	17·7
Carbohydrates	57·9	49·7	45·6	41·0
Fat	1·1	2·5	0·7	1·2
Fibre	25·5	26·3	36·2	31·9
Ash	13·1	6·9	5·2	8·2
Lime	1·852	..	..	1·6
Phosphoric Acid	0·201	..	..	0·507

DISEASES OF THE PIG.

E. J. SHELTON, H.D.A., Senior Instructor in Pig Raising.

EXTERNAL PARASITES OF THE PIG.

Blowflies.

The ordinary blowfly, also referred to as the Sheep Blowfly, is a source of considerable annoyance to livestock in this country, the damage and irritation resultant from infestation by the larvæ (maggots) of this fly being of considerable economic importance, though, as far as the pig raiser is concerned, the loss should be reduced to nil, provided the stock are carefully handled and given regular attention.

In the pig, infestation by fly maggots follows the attack of the insect upon wounds following the operation of castration or other operations, and from accidental causes. The fly deposits the living larvæ upon the wounds, and in burrowing into the tissues they immediately set up irritation, followed by pus formation. Unless the animal is given immediate attention, this irritation may result in complications such as will seriously reduce the commercial value. Treatment must, therefore, be largely preventive or such as would prove successful in dealing with wounds of any description.

Prevention and Treatment.

Preventive measures consist in efficient treatment of these open wounds, especially when they are noticed after pigs (boars in particular) have been fighting. The following healing ointments are recommended:—

Antiseptic Oils.—This recipe is specially advised for farm and homestead use for application to open wounds, sores, &c. It is made up by dissolving 1 ounce of iodoform in 14 fluid ounces of eucalyptus oil. When quite clear, add to it 1 pint of olive oil. Shake well, bottle, and label.

Another prescription suitable for use on aged pigs in which the wounds are large and the healing process more lengthy combines the active ingredients of the above with a more tenacious and adherent basis. Olive oil is replaced by stockholm tar. The formula in this case will be: Dissolve 1 ounce of iodoform in 14 fluid ounces of eucalyptus oil. When dissolved and quite clear, add 1 pint of stockholm tar. Shake well, bottle, and label distinctly as required.

These antiseptic oils are to be preferred from a humane and health standpoint, and as they stimulate natural healing processes, repel flies, and are to be recommended in preference to kerosene and fat or other local bush remedies, reliable as these may have appeared to be in days gone by.

Other Parasites.

Infestation by flies, fleas, mosquitoes, sandflies, bush ticks, &c., varies in its intensity in accordance with the care and attention given to pigs and by the environment in which they are kept. Stock kept on low-lying swampy areas are always liable to infestation by parasites such as mosquitoes. Pigs kept in paddocks in which there is an abundant growth of blady or bush grass are liable to bush tick infestation, while pig paddocks and yards on dry sandy ridges are more liable to infestation by fleas, sandflies, and mosquitoes than by ticks.

Prevention and Treatment.

Irritation caused by these parasites can, to a large extent, be prevented or reduced if ample supplies of disinfectant solution are available and are sprayed regularly over the sty walls and round the food troughs, water-pools, and wallows, and if the pens are kept clean and free from dust, mud, and rubbish, and if dung and urine-soaked bedding are regularly cleaned away and buried or ploughed in. Dung heaps are hotbeds for the breeding of parasites, and should not be permitted to accumulate. Plough all this matter in and the crops will benefit.

Where pigs and especially young stock do suffer as a result of infestation, it is wise to treat them, and thus prevent check in growth or development of other skin diseases following on abrasions by rubbing against posts, rails, &c.

An efficient and cheap skin dressing may be made up of buttermilk or skim milk and flowers of sulphur; this will tend to soften the skin and put it into good condition. Repeated washings with lukewarm water and the application of coconut and antiseptic oils or petroleum jelly will do an immense amount of good even if the animals are not heavily infested with parasites.

Control of Insect Pests.

The following formulæ for controlling insect pests in piggeries have been recommended by the Chief Entomologist, Mr. R. Veitch, Department of Agriculture and Stock, Brisbane:—

Flies.—Kerosene extract of pyrethrum will be found very efficient when used as a thin mist spray. This spray is made by soaking ½ lb. of fresh pyrethrum in 1 gallon of kerosene for two days in a covered vessel. The clear fluid is then decanted and used in the spray pump.

Fleas.—Kerosene emulsion: Dissolve 2 ounces of washing soap in 1 quart of boiling water. Remove from fire and gradually stir in 2½ pints of kerosene. The result should be a milky mass from which the oil does not separate. Water is then added to make 5 gallons.

Trypan Blue—A Specific for Bush Tick Paralysis.

Where scrub or bush ticks are suspected as being responsible for paralysis in pigs, it is recommended, particularly in the case of valuable animals and where scrub ticks are prevalent, that the animals should be thoroughly examined every second or third day, as it has been stated that these ticks do not harm the animals during the first four days of attachment.

It has been proved that trypan blue, injected under the skin, is a specific (or a suitable remedy) for this disease in the pig, for under careful treatment the paralysis soon improves and in a few days the animal thoroughly recovers; one dose of the trypan blue usually being sufficient.

Preparation of Solution.

A 2 per cent. solution (about 9 grains to the fluid ounce) is made by dissolving the trypan blue in boiling water, a sediment falling as the solution cools, and this should be removed by filtering through a funnel in which a properly folded filter paper is placed, or a fine piece of clean linen which has previously been boiled. The hypodermic syringe and needle, necessary in this form of treatment, before being used should be placed in a vessel containing cold water, then placed over the fire and the water boiled for ten minutes; this to thoroughly sterilize the syringe and needle, which is now ready for use when the solution to be injected has cooled.

The injection can be made anywhere under the skin, but the best positions are either in the front of the chest or behind the shoulder, the skin in these positions being loose, a fold of which is easily caught up. It is advisable to clip off the hair and disinfect the spot chosen before introducing the needle.

A dose for dogs, according to age and size, varies from 1 to 5 drachms, or 1 to 5 teaspoonfuls; the dose for calves, foals, and pigs, according to age and size, from ½ ounce to 2½ ounces, or 1 to 5 tablespoonfuls.

In general, it would be preferable for the pig raiser to have the solution prepared by a chemist to ensure accuracy of preparation and dosage.

Itching of the Skin.

Technically, itching of the skin is known as "pruritis." Pigs that are infested with external or internal parasites always appear to suffer from itching of the skin. Lice, ringworm, fleas, mange, ticks, mosquitoes, nettlerash, sunburn, sunscald, each give rise to this condition, and they are all a source of annoyance to stock that are neglected and have not the benefit of a comfortable, warm, dry shed in which to rest or sleep. In all these cases, careful observation will enable the farmer to gain some idea of the actual cause of the trouble and suggest suitable methods of treatment.

OTHER PESTS.

In addition to the internal and external parasites of the pig referred to, several other parasites are of importance, and these might be briefly referred to as parasites infesting preserved meats. They are of greater interest to manufacturers, wholesalers, and retailers than to producers, but are, nevertheless, of interest.

The Bacon Fly (*Piophila Casei*).—A cosmopolitan pest, and is better known to the manufacturer and retailer in the larval form—the larvæ being commonly known as jumpers. Besides bacon, the fly will readily breed in cheese, dried fish, and even in carrion. At times it has caused severe loss to bacon factories, but may be successfully combated by screening and maintaining highly sanitary conditions.

The Bacon Weevil (*Dermestes lardarius* and *Dermestes vulpinus* are not thought to cause very much loss in stored bacon, though their presence has been frequently reported. Their hairy larvæ are also to be found attacking skins and similar stored products.

FLIES, MOSQUITOES, FLEAS, AND LICE.

In common with other animals, pigs are often tormented by house flies, sand flies, and mosquitoes to such an extent that they can have no peace, and instead of lying down comfortably, as they should, they roam restlessly about all day long, and where fleas and lice also are present they spend very restless nights.

These troubles can, to a very large extent, be prevented by giving the pigs a daily dressing (only a very small quantity at each application) of oil to which a little kerosene is added. This will not only help keep external parasites at bay, but will also act as an antidote to actual irritation and bites. The pig has a tough skin and often carries a coarse coat of hair, but for all that his health may be prejudiced by parasitic infestation both external and internal. Where the skin is lacerated or badly sunburnt and cracked, blowflies and house flies swarm around and may be a source of danger to the animal. Wounds resultant from castration and other operations are favourable seats of attack by blowflies, and such wounds should be carefully watched and treated as required.

Some authorities advocate painting affected areas with a dilute solution of iodine, while zinc ointment or carbolised ointment are excellent dressings once the wounds have been thoroughly cleansed by washing or syringing out. Anything that can be done to reduce irritation and inflammation and assist healing will prove beneficial.

Prevention of attack is difficult, but something might also be attempted along these lines by getting rid of breeding grounds like manure heaps, where flies breed freely. Swampy areas are breeding places for mosquitoes and sand flies; and neglected accommodation and rubbish lying about harbours fleas and lice. A general spring cleaning is well worth while.

SUITABLE PIG FOODS.

Lucerne, either for grazing or for cutting and feeding in the sty, is the best green feed for the boar, sows, and young pigs. Wheat, oats, rye, and broadcast maize are also very suitable as green feeds for grazing; climbing varieties of cowpeas can be sown among the maize.

Sorghum should be fed only when mature. Rape is a fine winter crop, ranking next to lucerne for grazing purposes. Jerusalem artichokes are very hardy, and grow well in light soils. The pigs should be turned in to harvest these after the plants have flowered. Sweetpotatoes, suitable for warm districts of good rainfall, are good for pigs when fed with a small percentage of maize or other grains, and skim-milk; they are utilised in the same manner as artichokes for grazing.

Sugar beet and mangolds are excellent feed fed raw, and can be readily stored in a pit. Potatoes should be boiled and fed with skim-milk or maize; the water in which the potatoes have been boiled should not be given to the pigs. Pumpkins can be largely grown; they should be fed raw. Wheat and barley should be crushed and steamed for a few hours and fed with skim-milk or whey.

With regard to mill refuse (pollard, bran, and sweepings), the market value of these determines whether it pays to feed on them or not, but a very little pollard mixed in milk keeps pigs growing and fattening well. Bran, which is properly rather a laxative than a pig food, is very useful for brood sows. Sweepings from mills, &c., should be used carefully, as they often contain a lot of rubbish. It is wise to soak the sweepings, so that any nails, nuts off bolts, or similar dangerous foreign objects may sink and be separated.

Skim-milk, butter-milk, and whey are widely used as food for pigs. Skim-milk, which should be fed with crushed grains or pollard, is a good flesh-producing food. It should not be used straight from the separator, but allowed to stand an hour or so, so that the gas may work out of it. When feeding butter-milk, always add pollard or crushed wheat, barley, or maize; otherwise the pigs will be soft and blubbery when dressed. Whey also should only be fed when mixed with crushed grains.

To avoid any chance of tuberculosis, all milk products should be boiled before being fed to pigs.

THE GRAZING SELECTION.

POINTS IN SMALL FLOCK MANAGEMENT.

J. L. HODGE, Instructor, Sheep and Wool.

A GOOD start on the selection with sheep is infinitely to be preferred to a bad one, and the first move to achieve this is in the selection of the right type of ewe. No matter what preference the individual may have for a certain type of sheep, it is essential to success that he select a type suitable to the particular class of country he holds, the rainfall, the chances of hardship, and so on. To put the matter simply, that type of merino which may do splendidly in one district may be a total failure in another area. Generally speaking, the type selected should be of strong constitution without being so robust in the wool as to lose sight of quality. The rams to mate with these ewes is a most important question. In the vast number of cases the rams should be more or less close to the type of ewe grazed, and slightly stronger in the wool fibre. A strong contrast in the type of merino ewe and ram is not to be desired or encouraged. Too violent a contrast in breeding throws all ways.

CULLING.

Having firmly fixed in mind the type likely to do best and be most profitable *per head* in a particular district, it is necessary to establish this type, and the simplest and quickest method is by culling the ewes. Throw out of the flock any ewe which does not conform to the type already decided upon. Want of constitution, want of size, malformation, broadness in the wool fibre, possibly ultra fineness in the wool fibre, all constitute a reason for rejection. It is generally advisable for the selector to breed his own ewes, and with this object in view, the young ewes also should be gone through for culls at a time when they are showing sufficient length of fleece to make culling possible.

THE BLOW FLY JETTING.

The care of the flock is of the utmost importance and one of the pests most likely to be met with practically anywhere in Queensland where sheep are depastured is the attack of the blowfly. Very grave losses will occur unless an infestation is early detected and treated. If the attack is a bad one the best method to date takes the form of jetting. The formula used is arsenic, 7 lb.; washing soda, 5 to 7 lb.; and, if desired, 1 lb. of soft soap to the 100 gallons of water. The pressure used to get the ingredient on to the skin varies according to the length of the wool. From 120 lb. to the square inch up to 160 lb. should prove effective in most cases. I favour drafting off the sheep attacked by the fly and making up a hospital flock. These may then be observed daily and treated as required. Taking the blown sheep out of the flock also lessens the likelihood of attack to those sheep unaffected. In the case of ewes due to lamb I am not adverse to crutching.

INTERNAL PARASITES.

More likely during some portion of the year worms will make their presence felt in the flocks. This may easily be detected by unaccountable loss in condition, a generally unthrifty appearance, the humpty back, white skin, and a debilitated and anæmic condition generally.

The remedy is in drenching either with arsenic and Epsom salts, arsenic and bluestone, or bluestone and mustard. Particulars of all these remedies may be had on application to the Department of Agriculture and Stock. They are as follows:—

No. 1—

2 oz. arsenic.
6 lb. Epsom salts.
5 gal. water.

Doses—

Full grown sheep, 2 fluid oz.
Eight months to 15 months old, 1½ fluid oz.
Under 8 months old, 1 fluid oz.

No. 2—

2 oz. arsenic.
4 oz. bluestone
6 lb. Epsom salts.
5 gal. water.

Doses—

Full grown sheep, 2 fluid oz.
Eight months to 15 months old, 1½ fluid oz.
Under 8 months old, 1 fluid oz.

No. 3—

1 lb. fresh mustard.
1 lb. bluestone.
10 gal. water.

Doses—

Full grown sheep, 4 fluid oz.
Weaners, 12 months old, 3 fluid oz.
Lambs, 8 months old, 2 fluid oz.

External parasites consist of lice in sheep and ticks. The remedy is in dipping, and this operation should take place within one month or thereabouts after shearing. Care should be exercised in the choice of the material used for dipping, and the directions as to mixing followed exactly.

Lamb marking is an annual occurrence where breeding is gone in for, and should be done in an expert and cleanly manner.

All knives and instruments used in the operation should be thoroughly disinfected before using, and a vessel of disinfectant placed handy to the operator so that he may frequently use the disinfectant during the proceedings. Old dirty yards should be avoided, and when practicable hurdle yards erected in the paddock where the lambs and ewes are to be let go.

A preparation, both disinfectant and curative, should be applied to all lambs operated upon. Careful watch for the attacks of blowflies should be kept, and all lambs struck should be immediately dressed.

USE OF LICKS.

During the year it may be found that for no apparent reason, apart altogether from a worm infestation, the sheep are not doing as well as they should. This state of affairs is likely to occur when the feed is going off and the protein content of the grasses consumed is low. A sheep lick is indicated, and the ingredients given should be those to replace deficiencies in the pasture. As this subject is not a simple one it is advisable for those interested to state their particular case and circumstances to the Department. A prescribed lick for a certain set of circumstances is infinitely to be preferred to a lick which, apart from being costly, may be quite unsuited to the occasion.

CONSERVATION OF FODDER.

To my mind the time has long since arrived when consideration should be given to this most important question. Periods of drought may always be looked for, and it is economically wrong that losses should occur with such persistence.

Provision should be made in times of plenty and the fodder conserved for use in time of drought. On many sheep areas the country lends itself to the harvesting of bush hay. A quantity should be harvested each year when possible, and stored away from the ravages of the weather.

When financial circumstances permit it is advisable and economically sound to purchase well baled lucerne hay and maize grain at a price sufficiently low to merit the expenditure for the purpose indicated.

A careful perusal of the market reports over a period of years has convinced me that it is a justifiable business venture to purchase sheep feed for the purpose of conservation during flush years.

Certain properties may be so situated and served climatically that the owners could grow their own feed for winter feeding and for use in time of drought. This is to be encouraged from every point of view.

Lucerne hay has been as low in price as 50s. per ton, and maize has frequently in years past been at 2s. 3d. per bushel and under. At these prices, plus railage, both commodities would pay if used for the prevention of loss in the flocks in time of drought. The expenditure may be looked upon as a reserve or a form of insurance against loss.

SHEARING.

Shearing is harvest time for the woolgrower. Every care should be taken to remove the fleece with the smallest possible knocking about of the sheep. Apart from the actual shearing, there are other methods by which sheep are often treated roughly. Legging is to be discouraged. The shoots should not be too steep, and the sheep should be released down the shoot as gently as possible. All cuts should be dressed with an antiseptic and curative preparation. Sheep should not be too long in the sheds, and shorn sheep should be removed to their paddocks with as little delay as possible.

CLASSING THE CLIP.

As shearing time is harvest time for the selector, methods of achieveing the best possible financial results must be employed. Too much stress cannot be laid on the importance of correct classing. It is the duty of the classer to get up the clip honestly and in such a manner as best to display same to the buyer. I think the greatest mistake made at present is to be found in careless and too heavy skirting. Every fleece should be treated on its merits, and a reason forthcoming for whatever portion is skirted off. Too often wool rolling is undertaken by unskilled hands who treat every fleece in the same manner—an evident mistake. It is well to keep in mind that one should never force a line or "class up." If in doubt, put the fleece down, thus improving the top line by the *absence* of the particular fleece in question, and also improving the next line by the *inclusion* of the fleece referred to. So right through the clip from top fleeces down to locks.

In small clips the amount of wool available in a certain line should be either ascertained or carefully estimated, this with the idea of pressing so as to get five bales or more where that is possible, thus avoiding "Star" lots.

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Under the Commonwealth Postal Regulations it is NO LONGER PERMISSIBLE to indicate the expiry of subscriptions with a BLUE CROSS on the first page of the Journal. So in the future that reminder will NOT appear.

The need for the strictest economy makes any other form of reminder at present impracticable. THE ONUS OF REMEMBERING THE DATE OF EXPIRY OF, AND RENEWING THE SUBSCRIPTION PROMPTLY IS, THEREFORE, PLACED ON EACH SUBSCRIBER.

As about 1,000 subscriptions expire each month, the cost of a postal reminder is, in present circumstances, prohibitive. Readers will, therefore, appreciate that fact, and will, no doubt, help us to retain their names on our mailing list by kindly noting the date of payment of their subscriptions and, on expiry, sending in their renewals at once.

Instead of just sending the annual subscription—one shilling—along, it is suggested that, when renewing, they do so for two or three years, or even a longer term. For instance, FIVE SHILLINGS would keep a name on our subscribers' register for FIVE YEARS.

By doing this subscribers would help greatly in reducing clerical labour, as well as avoid the inconvenience to themselves of posting annually the very small sum necessary for their registration.

Readers renewing their subscriptions should USE THE ORDER FORM on another page, which should be filled in FULLY and CORRECTLY. Renewals by letter do not as a rule give the essential information, thereby causing unnecessary waste of time and much inconvenience. The Form is also our record, and orders which come by letter require special handling to adapt them to our card recording system.

When an address on the Order Form is not that to which the Journal has hitherto been sent, attention should be called to the new address, and the former address given. This assists us to identify subscribers, of whom we have many of the same name, often in the same district, as well as in different parts of the State.

Women subscribers should add to their names the word "Mrs." or "Miss," as the case may be. This is a constantly recurring omission, and its correction causes a lot of unnecessary labour in checking electoral rolls and other references. Wives and children of subscribers should apply in the subscriber's name, and so facilitate registration.

SILOS AND SILAGE.

By G. B. BROOKS, Director of Agriculture.

THE experiences of dairy farmers during the recent dry spell have convinced them of the necessity of having a store of fodder available for feeding to stock in periods of fodder shortage, both to maintain the milk supply and to save animals from death through starvation.

The welfare of the dairyman and the dairying industry generally demands that fodder should be conserved, not only for periods of severe drought but also for feeding to dairy stock as a supplementary ration during the off season, when the natural pastures have lost much of their feeding value.

Fodder, to be conserved in the form of silage, need not necessarily necessitate a large capital outlay for the construction of concrete structures, although the latter are to be preferred where their erection is practicable.

The growing of a crop of succulent material and the preservation of such for an extended period in a condition palatable to stock is an operation that can be carried out by a farmer without previous experience in silage-making.

Successful silage production really consists in, first of all, expelling the air entangled in the green material, and then its exclusion, and the more complete the exclusion the more perfect is the silage.

There are two methods in vogue for attaining this objective. One is to stack the green crop in the open and to apply the necessary pressure to consolidate it into a solid airtight mass, and the other is to conserve it in an airtight compartment or container.

STACK STORAGE.

This has generally been looked upon as being a simple and the least costly method of storing material in a succulent state. The main drawback to the stack is the large amount of wastage that takes place through exposure to the atmosphere, while the raising of the bulky green material over the framework also takes up a good deal of time.

Full particulars in regard to the erection of framework and lifting equipment are detailed in a pamphlet on stack silage procurable from the Department of Agriculture and Stock, Brisbane.

PIT SILO.

This silo has several features to commend it. It can, for instance, be located in a hayshed and floored over, or it can be out in the open and protected by a roof. It will be found invariably that the cost of excavating a pit, if labour is allowed for, will be just as expensive as a concrete structure. The top portion at least will have to be bricked or concreted, and, should the subsoil be unsuitable to provide reasonably smooth sides, this will have to be continued to the whole depth. It is advisable to raise the silo over ground level to the extent of several feet either by a brick or concrete wall, which will increase the capacity and also be a protection against straying stock. To obviate the necessity of raising the cutter, a door can be left in a convenient position for filling. A feature of considerable importance in a pit is that it can be easily filled with chaffed material, the equipment necessary being much less expensive than that required for an overground structure.

In the event of an ordinary chaffcutter being used, it is suggested that the crop grown be either sorghum, sudan, or one of the panicum family. The heavy maize stalks are liable to smash up the usual type of farm chaffcutter. A 2 h.p. engine will generally be found to give sufficient power for chaffing material to fill a pit.

When filling is completed a heavy layer of green grass or lucerne should be spread over the surface and well trodden down. Heating invariably commences in the centre, causing rapid sinking; consequently a few minutes should be spent every other day for, say, a fortnight after filling in treading it down against the walls in order to prevent the access of air.

OVERGROUND SILOS.

In countries where it is the general practice to conserve green material in the form of silage concrete is looked upon as being the most serviceable material for the erection of a silo. A concrete silo is fire, ant, and acid proof, and is, moreover, practically everlasting.

In regard to cost: This depends very largely upon circumstances, such as the distance sand and gravel have to be transported and whether skilled labour would be employed in the construction. If let by contract the cost would probably be in the

neighbourhood of thirty shillings per ton. Plans and specifications of various sizes of concrete silos are available on application to the Under Secretary, Department of Agriculture and Stock, Brisbane.

The expense entailed in providing equipment for the filling of overground silos, more particularly those of 100 tons and over capacity, is fairly considerable. An ensilage cutter with either a blower or elevator attachment is really a necessity if large quantities of material have to be handled. To operate this machine, at least a 5-h.p. engine would be required. An ordinary farm chaffcutter, to which an elevator has been attached by a link-belt chain, is sometimes used for chaffing ensilage; but in handling, say, a heavy crop of maize, it is likely to prove an endless source of trouble.

SILO CONSTRUCTION.

Galvanised Iron.

Silos built of galvanised iron have not been a success. The acids not only destroy the iron, but variation in temperature detrimentally affects the ensilage adjacent to the walls, causing mould.

Fibro-Cement.

Silos constructed of fibro-cement sheeting attached to heavy studding in octagonal form have, on the whole, been found satisfactory. Care, however, has to be exercised in the use of forks in handling the material inside the silo.

The capacity of a circular silo 14 feet in diameter and 24 feet high would be approximately 60 tons. A 16 feet by 30 feet silo would hold approximately 130 tons.

Silo Moulds.

The Department of Agriculture and Stock has a number of moulds for use in the erection of circular reinforced concrete silos. These moulds, which are of three sizes—viz., 14 feet, 15 feet, and 17 feet diameter, respectively—are loaned to farmers for silo construction free of charge, but on condition that the borrower pays all transport charges on both forward and return journeys between the Department's store in Brisbane and the site where the silo is to be erected. The borrower also is required to give an undertaking that the moulds will be returned in good order and condition and free from any adhering film of cement as soon as possible after the job is completed.

SILAGE CROPS.

In the selection of a crop suitable for silage it will be found that there is a large variety to choose from. Maize is probably the most popular, producing a heavy yield of material and giving good-quality silage. As an all-round crop suitable to wide variations in soil and climate sorghum is outstanding. Although its feeding value is slightly lower than that of maize, its cropping qualities are bettered by some 5 tons per acre. The yield of maize or sorghum varies from 15 to 30 tons per acre, according to the conditions under which they are grown.

By using a maize binder the cost of handling those crops can be very materially reduced than if harvested either by hand or slide cutter.

Sudan grass, panicums, and millets are most useful crops for silage, more particularly when a wheat binder is available for harvesting. The approximate yields that may be expected from those crops are—Sudan and White Panicum, 12 tons; Common Panicum, 10 tons; and Japanese Millet, 9 tons per acre.

COMMON CAUSES OF SECOND-GRADE CREAM.

Of the various causes of second-grade and "border-line" cream there is none so common as the contamination resulting from inefficient washing of dairying utensils. Such contamination may result from—

Failing to wash up twice daily. Washing up with cold water, either once or twice per day. Leaving the separator unwashed at night. Failing to use washing soda to remove grease from utensils. Using objectionable cloths or unclean brushes for washing up. Failing to scald thoroughly all utensils, brushes, &c., after washing. Failing to wash and scald cans on their return from the factory. Washing up utensils in polluted water—rainwater is always preferable.

There are many other ways, of course, in which the dairy farmer, sometimes unwittingly, may jeopardise the quality of his product.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advanced Register of the Herd Book of The Jersey Cattle Society, The Australian Illawarra Shorthorn Society, and The Friesian Cattle Society, production charts for which were completed during the month of October, 1932 (273 days period unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
	JERSEY.	Lb.	Lb.	
	Mature Cows (over 5 Years), Standard 350 Lb.			
Glenview May	F. P. Fowler and Sons, Coalstoun Lakes	6,469·5	399·791	Carlyle Larkspur 2nd Empire
Seycombe Mavis	A. E. Trigger, Dideot	5,944·5	372·097	Oxford Northwood King
Golden Devon Lassie 5th	F. P. Fowler and Sons, Coalstoun Lakes	5,708·4	364·336	Oaklands King Bee
	Senior, 4 Years Old (between 4½ and 5 Years), Standard 330 Lb.			
Upwell Miss North	A. E. Trigger, Dideot	5,928·35	371·702	Oxford Northwood King
	Junior, 4 Years Old (between 4 and 4½ Years) Standard 310 Lb.			
Pearlie of Brook Lodge	H. T. Mayers, Nambour	6,858·49	404·275	Butterboy of Brooklodge
	Senior, 3 Years Old (between 3¾ and 4 Years), Standard 290 Lb.			
Pansy of Billabong	J. Mollenhauer, Moffatdale	5,637·93	362·093	Premier of Calton
Marjorie 2nd of Newhills	J. Nicol Robinson, Maleny	6,394·45	342·335	Prince Harry of Newhills
	Junior, 3 Years Old (between 3 and 3½ Years), Standard 270 Lb.			
Coronada (247 days)	J. Sinnamon, Moggill	6,107·16	341·481	Wonderful Volunteer
Rosevale Lady Nancy	H. F. Rowe, Kenilworth	5,838·4	328·736	Prince Victor of Banyule
Creamy's Empress of Inverlaw	R. J. Crawford, Inverlaw	6,548·7	326·649	Linda 4th's Millstream 4th
	Junior, 2 Years Old (under 2½ Years), Standard 230 Lb.			
Pineview Duchess	Hunter and Sons, Borallon	5,611·25	336·597	Oxford Buttercups Noble
Glenview Alfriston Una	F. P. Fowler and Sons, Coalstoun Lakes	4,824·75	305·977	Glenview Alfriston Duke
Newhills Crocus Bud	J. Nicol Robinson, Maleny	4,617·3	271·049	Prince Harry of Newhills
Rosevale Foxlove	H. F. Rowe, Kenilworth	4,890·1	265·889	Burnside Hercules
Molly of Burnleigh	W. W. Mallett, Nambour	4,543·5	265·566	Gold Top of Burnleigh
	AUSTRALIAN ILLAWARRA SHORTHORNS.			
Tottie IV. of Golelea	E. M. Franklin, Wonglepong	6,866·15	269·32	Limelight of Raleigh
College Marie	Queensland Agricultural High School and College, Gatton	7,407·78	262·336	College Heir
Wandegong Daisy	G. D. Lindenmayer, Mundubbera	6,660·5	260·136	Emperor of Spurfield
	FRIESIAN.			
	Junior, 2 Years Old (under 2½ Years), Standard 230 Lb.			
Oaklands Holly 5th	W. Richters, Tingoora	7,669·33	292·866	Pied Rock

Answers to Correspondents.

BOTANY.

Selected from the outward correspondence of the Government Botanist, Mr. Cyril White, F.L.S.

Hexham Scent.

R.C.B. (Chinchilla)—

The specimen is *Melilotus parviflora*, the Melilot or Hexham Scent common as a naturalised weed in Queensland. It is sometimes known as Yellow Lucerne. It has some value as a fodder, especially in localities where ordinary lucerne and clovers will not thrive. It is, however, of annual duration and dies out with the approach of hot weather. This plant was boomed some years ago as a fodder under the name of King Island Melilot, but has never taken on to any extent, probably owing to the fact that the plant taints milk and butter rather badly with its peculiar strong odour. Stock seem rather fond of the plant when it is going off, but as far as our experience goes they do not seem to care for it very much in its younger and more luxuriant stages.

Stink Grass.

J.H.McC. (Hughenden)—

The specimen is *Eragrostis ciliaensis*, the Stink Grass, a grass with a very wide distribution over the warm regions of the world. It is naturalised in Queensland and New South Wales, and has been established for many years. It is generally regarded as of little or no fodder value. In Southern Queensland it mostly grows as a weed of cultivation, along railway lines, in waste places, or, in fact, anywhere where the ground has been disturbed.

Milk Tainting Weeds.

T.D.B. (Brigalow)—

1. *Sisymbrium orientale*, the Tumbling Mustard or Oriental Rocket, a common weed in cultivation and a bad weed to taint milk.
2. *Lepidium ruderale*, Pepper Cress, an exceedingly bad weed to taint milk, very abundant in Queensland in cultivation and in pasture lands.
3. *Rapistrum rugosum*, Giant Mustard or Turnip Weed, a very bad weed to taint milk.

All three plants belong to the Mustard family, Cruciferæ, and are common plants, widely spread over the warm temperate regions of the world as farm weeds.

Mustard Tree.

C.H.W. (Pittsworth)—

The specimen is not Needlewood, but *Apophyllum anomalum*, commonly called Mustard Tree. In spite of its wiry branches, it seems to be quite readily eaten by stock and is said to be rather a valuable fodder. It does not grow to any great size, and we do not know that the wood has any particular value.

Prairie Grass.

N.Z. (Gradule)—

The specimen is the Prairie Grass, *Bromus unioloides*. It is an annual grass, but is one of the best winter fodders in Queensland. Seed is obtainable through the ordinary commercial channels. Seed should be sown in the autumn, and is commonly sown along with clover, about 20 lb. of prairie grass and about 10 lb. of clover seed to the acre.

Tie Bush.

V.R. (North Arm)—

The specimen is *Wickstroemia indica*, sometimes known as Tie Bush. The local name refers to the fibrous nature of the bark. This shrub has been accused of poisoning stock on various occasions and has rather an evil reputation among stock owners. A few years ago feeding experiments were conducted at the Animal Health Station, Yeerongpilly. At the end of the experiment the animals were emaciated, and during the course of feeding they developed diarrhœa and passed a certain amount of blood with the fæces. They recovered, however, when put on to normal feed again, and we should say they certainly ate more of the shrub than they would have under natural conditions.

Milk Tainting Weeds (Pepper Cress, Wild Carrot, Fish Weed, Stagger Weed, Indigo, Snuff Weed).

A.A. (Gatton)—

The specimens have been determined as follows:—

1 and 2. Both forms of *Lepidium ruderale* (Pepper Cress). One of the worst milk-tainting weeds we possess.

3. *Apium leptophyllum*, generally called Wild Carrot, though this name more correctly belongs to an allied plant, *Daucus brachiatus*. Both are bad milk-tainting weeds.

4. *Senebiera didyma* (Bitter Cress or Wart Cress). An exceedingly bad milk-tainting weed.

5. *Chenopodium triangulare* (Fish Weed). As the name suggests, this plant gives a somewhat fishy flavour and odour to milk and cream. It is quite a useful fodder, but has bad tainting properties.

6. *Stachys arvensis* (Stagger Weed or Wild Mint). This plant causes staggers or shivers in working stock, but ordinary resting paddock stock seem to be quite unaffected by it; in fact, it is generally looked upon by dairymen as a useful fodder. We do not know the extent to which it would taint milk, but like a great many of these herbaceous plants it would probably give a somewhat weedy flavour.

7. *Indigofera australis*, a species of Indigo very common in the Lockyer Valley. It has been suspected of being poisonous to stock, but feeding tests have always given negative results.

8. *Centipeda orbicularis*, sometimes called Snuff Weed. We should say this weed would taint milk badly, but doubt if stock would eat it in anything but very minute quantities.

Wild Mint.

E.W.C. (Gympie)—

The specimen is the Wild Mint or Narrow-leaved Sage, *Salvia lancifolia*, a native of North America, which has appeared as a weed in the Pittsworth district, and is now gradually spreading to other parts of the State. This plant was responsible for serious losses in travelling stock some little time ago, and feeding tests have since proved it to be very poisonous. Its immediate eradication is, therefore, recommended.

Groundsel.

S.K.K. (Pomona)—

The specimen is *Baccharis halimifolia*, the Groundsel Bush, a native of South America, now a common naturalised weed and a great pest in several localities in Queensland. It has been accused of poisoning stock, but feeding tests carried out some years ago at the Animal Health Station, Yeerongpilly, gave negative results. After about a fortnight's feeding on the plant the animals were merely very emaciated, thus proving that though the plant may not actually be poisonous it has no fodder value whatsoever. If your loss of cows was due to vegetable poisoning, we should say some plant other than the Baccharis was the cause of the trouble.

Points in Pig Feeding.

E.J.C. (Caboolture)—

Tomatoes, cucumbers, and pineapples are all foods which may be used to advantage in the feeding of pigs, but, of course, their commercial value usually means that they are too expensive to be classed as profitable pig foods, and when their value is reduced by bruising, damage, and decay, their food value is also reduced, and they become risky, and sometimes even poisonous. Most fruits carry less food value when unripe than when fully matured, and this refers to tomatoes as well as others, though there is no actual danger of poisoning in feeding green tomatoes, provided, of course, they are fed in conjunction with other more concentrated feeding stuffs, like pollard, and barley meal. From the point of view of checking diseases and parasites, most fruits are better fed in a cooked form, this referring to unripe fruit also.

General Notes.

Staff Changes and Appointments.

Department of Agriculture and Stock,
Brisbane, 3rd November, 1932.

Mr. John Smith, general manager of the Farleigh sugar mill has been appointed millowners' representative on the Farleigh Local Sugar Cane Prices Board, vice Mr. D. L. McBryde, resigned.

Mr. R. S. Sigley, Dairy Inspector, Crow's Nest, has been transferred to Cooroy, and Mr. D. F. Keith, Dairy Inspector, from Cooroy to Crow's Nest.

A rearrangement of the headquarters of a number of stock inspectors has been made in the Department of Agriculture and Stock; and, in future, the following officers will be stationed at the places mentioned:—

J. B. Cardno	Winton.
J. P. Dowling	Gayndah.
D. Culhane	Toogoolawah.
A. G. Smyrell	Bowen.
W. J. Sheahan	Clermont.
S. C. O. Jessop	Toowoomba.
J. J. Shelvey	Helidon.
H. A. McDonald	Jandowae.
J. Wyvill	Helidon.
S. B. Myles	Kingaroy.
C. P. Joyner	Kingaroy.

Mr. E. Broughton, Elimbah, has been appointed an Honorary Inspector under the Diseases in Plants Acts.

Mr. A. F. Uhlmann has been appointed an Honorary Ranger under the Animals and Birds Acts, in respect of the Kipper Ring Lagoons, near Redcliffe.

Grade Standard for Plums.

A Regulation has been issued under the Fruit and Vegetables Act, providing for a grade standard for plums marketed in Queensland.

The Regulation provides that no variety of plum shall be sold in the State of a lesser diameter than the minimum prescribed for the undermentioned varieties:—

1¼ inch.	1½ inch.
Little Gem	Burbank
Evans's Early	Giant Prune
Blue Rock	Pond's
Tibbits	President
Early Orleans	Grand Duke
	Black Diamond
	Magnum Bonum
	Coe's Golden Drop
1¾ inch.	Kelsey
Doris	Wickson
Duffy's	Ballina
Wright's Early	Shiro
Santa Rosa	Beauty
Wilson	Formosa
Angelina Burdett	Sultan
	October Purple

Brumbies on Beerburrum Settlement.

A Proclamation has been issued declaring the Parishes of Beerwah and Canning, situated in the Brisbane Stock District, to be a district for the control of "brumbies" or wild horses for the period from 1st December, 1932, to 31st March, 1933.

The Beerburrum Tobacco Settlement is embraced in the abovementioned parishes, and numbers of horses which have been running wild in the scrub have been causing much concern to the settlers in the district. Action can now be taken during the period specified above to rid the settlement of trouble from straying stock.

Rural Topics.

Butter Fat Content of Milk.

The butter fat content of the first and subsequent deliveries of milk drawn from a cow varies considerably as will be noted from an analysis of the milk from three cows as tabulated hereunder :—

—	Cow No. 1 Fat Per Cent.	Cow No. 2 Fat Per Cent.	Cow No. 3 Fat Per Cent.
First portion	0·90	1·60	1·60
Second portion	2·60	3·20	3·25
Third portion	5·35	4·10	5·00
Fourth portion (strippings)	9·80	8·10	8·30

Weights of Bacon Pigs.

The following simple method of estimating the approximate dressed weight of pork and bacon pigs when the actual live weight is known is worth noting. Assuming that the actual live weight of a prime quality bacon pig is 170 lb., and that it is desired to estimate the dressed weight, as is done in Queensland in the purchase of pigs by the proprietary bacon factories—

Actual live weight, 170 lb.

Deduction between live weight and dressed weight averages about 30 per cent. Multiply the actual weight (170 lb.) by 7. From the result (1,190) cancel the nought, or last figure, and the remaining figures (in this case 119) will represent the approximate dressed weight in pounds.

Thus, a pig weighing 170 lb. alive is estimated to dress out at 119 or 120 lb. This may not be actually correct, but it is a good estimate that for practical purposes will be found to fill the bill and prevent undue errors in marketing, as 30 per cent. off is a general deduction, allowing both for the actual loss in offal at slaughter and shrinkage in transit between farm and factory. The actual loss is heavier in light-weight pigs and lighter in the heavier weights.

To Prevent Calves Sucking Each Other.

When calves are fed in separate pens, do not release them until the taste of the milk ration has left the mouth. When calves are four weeks old they should be given a small ration, such as bran or ground meals, in a dry state in a trough, so as to be available as soon as they have finished their liquid ration. They will be occupied in consuming the dry ration until the taste of the milk has left their mouths and will start picking the pasturage. The calves should at all times have access to a clean supply of drinking water. Do not allow calves to run with heifers, as the calves sucking the udder may cause udder troubles when the heifer freshens.

A Lonely Bush Grave.

In answer to a correspondent seeking the history of a lonely, but well-tended grave, near Dalby, Mr. J. Shaw Thompson, editor and proprietor of the "Dalby Herald," has courteously given us the following information:—

In regard to the grave at the foot of the Bunya Mountains, this is known as "Gertrude's Grave." It is fenced and has a headstone engraved: "Maria Gertrude Carbines, 15/5/1840-17/5/1866," and on the reverse: "This hallowed spot is Gertrude's Grave." This pioneer woman died in childbirth while her husband was on his way to Dalby for medical assistance. The grave was regularly attended and the fence painted, up to 1914, by someone, presumably the husband. After that, the grass grew over the grave and the fence fell into disrepair, and whoever had been tending the grave (and no one knows whom) had either died or removed very far away. In 1923 attention was drawn to the neglected grave by Mr. Abraham Hertzberg, who visited the mountains that year; and, as a result, the grave was restored and an iron fence erected by the people of Dalby, and the grave is now regularly looked after.

The Home and the Garden.

OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staff of the Queensland Baby Clinics, dealing with the welfare and care of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable cases of infant mortality.

INFANTILE DIARRHŒA.

It is not many years since large numbers of babies in Queensland died every year from diarrhœal diseases. During the years 1890 to 1903 every tenth baby born died before reaching its first birthday (from all causes). During the past five years this mortality has been reduced to much below one in twenty. On our annual birth rate, which is not far from 20,000, this has meant the saving of more than 1,000 lives every year, which is surely a remarkable fact. Diarrhœal diseases, often occurring in formidable epidemics in summer months, were the largest cause of the former high death rate. Infectious diarrhœa now causes few deaths, but, like a snake in the grass, it is still venomous.

Our Best Defence.

Against this our best defence, and our only hope for reducing deaths from diarrhœa to a minimum, is a clear understanding of its causation. Unfortunately, there has been no subject on which more obscurity, more confused thinking, more foolish traditions and absurd beliefs have been prevalent. All these have been a direct cause of the high mortality. Until recently nearly every mother when asked the cause of her baby's illness, would reply, as a matter of course, "teething," and many think so still, though it is nonsense. This deadly nonsense has been the cause of innumerable infant deaths. Teething never killed anybody. Recently some mothers will tell us that the cause is "gastro-enteritis," or as they call it for short, "gastritis." Unfortunately these are but names. They convey no knowledge, but hide much ignorance. They are just big words, which send the mind to sleep.

Let us try to make this matter so clear that even the simplest, if they will only attend, can understand. Diarrhœa is the passage of frequent loose or watery motions. It is caused by the presence of some irritating material in the bowels. The bowels are trying to expel this, and so the motions are frequent. The contents of the bowel are being hurried through, and so they are watery. All sorts of things will cause diarrhœa in babies, but we may divide them into two classes.

Food Diarrhœas.

These may occur in artificially fed babies at any time, but are more frequent during hot weather. The baby is given unsuitable food or more food than he can digest, so that the excess ferments inside. Sometimes the system of feeding is wrong. Sometimes his mother is feeding him carefully, but kind friends give him things he ought not to have. If he has learnt to crawl, he may have picked up some rubbish and swallowed it. Perhaps he is being given cow's milk which is stale or dirty and rapidly becomes irritating in hot weather. Perhaps he has been very thirsty on a hot day, and his mother, instead of giving him water, has given him too much milk. Perhaps he has had a feverish illness, and his mother has

kept him on full diet instead of giving him more water and less food. All these things cause diarrhœa. The treatment is very simple. Give him a teaspoonful of castor oil to help to clear out the irritating material. Give him no milk and stop all food, but let him drink plenty of very weak barley water. Keep him on this one, two or three days. When he improves give him scalded whey made from junket. If over eight or nine months he may also have arrowroot, cornflour, or sago boiled with water, and if really hungry a small finger of baked bread. When his motions get right, add milk to his food gradually. So treated, most cases of food-diarrhœa get well rapidly. Only long-standing and neglected cases are obstinate and sometimes waste and die.

Infectious Diarrhœas.

These occur especially in the early summer, and are a much more serious matter. Your baby has swallowed disease germs, living bacteria, which are the cause of his illness. Often the attack begins suddenly with high fever and much weakness. Often it begins gradually, so that you may think it a simple food-diarrhœa, but in spite of castor oil and barley water you find baby is no better next day, but worse. Medical treatment is urgently necessary in all these cases, and you should see a doctor at once.

But the responsibility for preventing these illnesses, for keeping germs from getting inside the baby, rests with his mother. If the baby is on the breast he runs very little risk with ordinary care. If he is bottle-fed you must take the greatest care. Do not blame the milkman. Boiling or pasteurising kills all disease germs. Therefore the germs must have got into the milk after boiling or pasteurising. They were carried there by flies or by the mothers fingers, and they can be carried into foods made from dried or condensed milk just as easily. The flies may have deposited the germs on the rubber teats, or on the dummy, which you know the baby ought not to have. Constant care and watchfulness are the baby's safeguards. If you do not know how to keep the baby's food safe from infection, the nurse at the baby clinic will show you. Do not wait until your baby is sick, for then it may be too late.

Orchard Notes for January.

THE COASTAL DISTRICTS.

ALL orchards, plantations, and vineyards should be kept well cultivated and free from weed growth; in the first place, to conserve the moisture in the soil, so necessary for the proper development of all fruit trees and vines; and, secondly, to have any weed growth well in hand before the regular wet season commences. This advice is especially applicable to citrus orchards, which frequently suffer from lack of moisture at this period of the year if the weather is at all dry, and the young crop of fruit on the trees is injured to a greater or less extent in consequence.

Pineapple plantations must also be kept well worked and free from weeds, as when the harvesting of the main summer crop takes place later on, there is little time to devote to cultivation. If this important work has been neglected, not only does the actual crop of fruit on the plants suffer, but the plants themselves receive a setback.

Banana plantations should be kept well worked, and where the soil is likely to wash badly, or there is a deficiency of humus, a green crop for manuring may be planted. Should the normal wet season set in, it will then soon cover the ground without injury to the banana plants. When necessary, banana plantations should be manured now, using a complete manure rich in potash and nitrogen. Pineapples may

also be manured, using a composition rich in potash and nitrogen, but containing no acid phosphate (superphosphate) and only a small percentage of bonemeal, ground phosphatic rock, or other material containing phosphoric acid in a slowly available form.

Bananas and pineapples may still be planted, though it is somewhat late for the former in the more southern parts of the State. Keep a good lookout for pests of all kinds, such as Maori on citrus trees, scale insects of all kinds, all leaf-eating insects, borers, and fungus pests generally, using the remedies recommended in Departmental publications.

Fruit fly should receive special attention, and on no account should infested fruit of any kind be allowed to lie about on the ground to become the means of breeding this serious pest. If this is neglected, when the main mango crop in the South and the early ripening citrus fruits are ready, there will be an army of flies waiting to destroy them.

Be very careful in handling and marketing of all kinds of fruit, as it soon spoils in hot weather, even when given the most careful treatment. Further, as during January there is generally more or less of a glut of fresh fruit, only the best will meet with a ready sale at a satisfactory price.

Grapes are in full season, and in order that they may be sold to advantage they must be very carefully handled, graded, and packed, as their value depends very much on the condition in which they reach the market and open up for sale. Well-coloured fruit, with the bloom on and without a blemish, always sells well, whereas badly coloured, immature, or bruised fruit is hard to quit.

One of the greatest mistakes in marketing grapes is to send the fruit to market before it is properly ripe, and there is no better way to spoil its sale than to try and force it on the general public when it is sour and unfit to eat.

Bananas for sending to the Southern States require to be cut on the green side, but not when they are so immature as to be only partially filled. The fruit must be well filled but show no sign of ripening; it must be carefully graded and packed and the cases marked in accordance with the regulations under the Fruit Cases Acts and forwarded to its destination with as little delay as possible.

Pineapples should be packed when they are fully developed, which means that they contain sufficient sugar to enable the fruit to mature properly. Immature fruit must not be marketed, and if an attempt is made to do so the fruit is liable to seizure and the sender of the fruit to prosecution under the abovenamed regulations. Further, the fruit must be graded to size and the number of fruit contained in a case must be marked thereon. Immature fruit must not be sent. For canning, the fruit should be partly coloured; immature fruit is useless; and overripe fruit is just as bad. The former is deficient in colour and flavour and the latter is "winey" and of poor texture, so that it will not stand the necessary preparation and cooking.

Should there be a glut of bananas, growers are advised to try and convert any thoroughly ripe fruit into banana figs.

The fruit must be thoroughly ripe, so that it will peel easily, and it should be laid in a single layer on wooden trays and placed in the sun to dry. If the weather is settled, there is little trouble, but if there is any sign of rain the trays must be stacked till the weather is again fine, and the top of the stack protected from the rain. To facilitate drying, the fruit may be cut in half lengthways. It should be dried till a small portion rubbed between the finger and thumb shows no sign of moisture. It can be placed in a suitable box to sweat for a few days, after which it can be dipped in boiling water to destroy any moth or insect eggs that may have been laid on it during the process of drying and sweating. It is then placed in the sun to dry off any moisture, and when quite dry it should be at once packed into boxes lined with clean white paper. It must be firmly packed, when, if it has been properly dried, it will keep a considerable time. It can be used in many ways, and forms an excellent substitute for raisins, sultanas, currants, or other dried fruits used in making fruit cakes and other comestibles. Banana figs will be found useful for home consumption, and it is possible that a trade may be built up that will absorb a quantity of fruit that would otherwise go to waste.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

JANUARY is a busy month in the Granite Belt, and orchardists are fully occupied gathering, packing, and marketing the crop of midseason fruits, consisting of plums of several kinds, peaches, nectarines, pears, and apples. The majority of these fruits are better keepers and carriers than those that ripen earlier in the season; at the same time, the period of usefulness of any particular fruit is very limited, and it must be marketed and disposed of with as little delay as possible.

With the great increase in production, owing to the large area of new orchards coming into bearing and the increasing yields of those orchards that have not come into full profit, there is not likely to be any market for immature or inferior fruit. There will be ample good fruit to fully supply the markets that are available and accessible. Much of the fruit will not carry far beyond the metropolitan market, but firm-fleshed plums, clingstone peaches, and good firm apples should stand the journey to the Central District, and, if they are very carefully selected, handled in a manner to prevent any bruising, and properly graded and packed, they should carry as far as Townsville. Growers must remember that, given a market fully supplied with fruit, only such fruit as reaches that market in first-class condition is likely to bring a price that will pay them; consequently the grower who takes the trouble to send nothing but perfect fruit, to grade it for size and colour, to pack it carefully and honestly, placing only one-sized fruit, of even quality and even colour, in a case and packing it so that it will carry without bruising, and, when opened up for sale, will shew to the best advantage, is pretty certain of making good. On the other hand, the careless grower who sends inferior, badly graded, or badly packed fruit is very likely to find when the returns for the sale of this fruit are to hand that after paying expenses there is little, if anything, left. The expense of marketing the fruit is practically the same in both cases.

Then why "spoil the ship for a ha'p'orth of tar" after you have gone to the expense of pruning, spraying, manuring, and cultivating your orchard? Why not try and get a maximum return for your labour by marketing your fruit properly? The packing of all kinds of fruit is a fairly simple matter, provided you will remember—

(1) That the fruit must be fully developed, but yet quite firm when gathered.

(2) That it must be handled like eggs, as a bruised fruit is a spoilt fruit, and, when packed with sound fruit, spoils them also.

(3) That only one-sized fruit, of an even degree of ripeness and colour, must be packed in a case.

(4) That the fruit must be so packed that it will not shift, for if it is loosely packed it will be so bruised when it reaches its destination that it will be of little value. At the same time, it must not be packed so tightly as to crush the fruit.

If these simple rules are borne in mind, growers will find that much of the blame they frequently attribute to the fruit merchants or middlemen is actually the result of their own lack of care. Fruit that opens up in the pink of condition sells itself, whereas any fruit that opens up indifferently is hard to sell on any except a bare market, and on a glutted market is either unsaleable or realises such a poor price that the grower is frequently out of pocket and would have been better off had he not attempted to market it.

If spraying with arsenate of lead, and systematic bandaging, has been properly carried out, there will be comparatively few codlin moths to destroy the later ripening pip fruits; but if these essential operations have been neglected or carelessly carried out a number of moths will hatch out and the eggs laid by them will turn to larvæ that will do much damage, in some cases even more than that caused by the first broods that attack the fruit as soon as it is formed. Where there is any likelihood, therefore, of a late crop of moths, spraying with arsenate of lead must be continued if the late crop of pip fruits is to be kept free from this serious pest.

Fruit fly must be systematically fought, and on no account must any fly infected fruit be allowed to lie about on the ground and breed this pest, to do further damage to the later ripening fruits.

Citrus orchards will need to be kept well cultivated in the drier and warmer parts of the State, and, where necessary, the trees should be irrigated. If scale insects are present, the trees should be either sprayed, or, better still, treated with hydrocyanic acid gas.

Western grapes are in full season, and if they are to be sent long distances by rail then they are all the better to be cut some hours before they are packed, as this tends to wilt the stems and keep the berries from falling off in transit. The fruit must be perfectly dry when packed, and should be as cool as possible. It must be firmly packed, as a slack-packed case always carries badly and the fruit opens up in a more or less bruised condition.

Farm Notes for January.

FIELD.—The main business of the field during this month will be ploughing and preparing the land for the potato and other future crops, and keeping all growing crops clean. Great care must be exercised in the selection of seed potatoes to ensure their not being affected by the Irish blight. Never allow weeds to seed. This may be unavoidable in the event of long-continued heavy rains, but every effort should be made to prevent the weeds coming to maturity. A little maize may still be sown for a late crop. Sow sorghum, imphee, Cape barley, vetches, panicum, teosinte, rye, and cowpeas. In some very early localities potatoes may be sown, but there is considerable risk in sowing during this month, and it may be looked upon merely as an experiment. Plant potatoes whole. Early-sown cotton will be in bloom.

On coastal and intercoastal scrub districts, where recently burnt-off scrub lands are ready for the reception of seed of summer-growing grasses, sowing may commence as soon as suitable weather is experienced. Much disappointment may be saved, and subsequent expenditure obviated, by ensuring that only good germinable grass seed is sown, of kinds and in quantities to suit local conditions, the circumstances being kept in mind that a good stand of grass is the principal factor in keeping down weeds and undergrowth.

In all districts where wheat, barley, oats, canary seed, and similar crops have recently been harvested, the practice of breaking up the surface soil on the cropped areas should invariably be adopted. Soil put into fit condition in this way will "trap" moisture and admit of the rains percolating into the subsoil, where the moisture necessary for the production of a succeeding crop can be held, provided attention is given to the maintenance of a surface mulch, and to the removal, by regular cultivation, of volunteer growths of all kinds. If not already seen to, all harvesting machinery should be put under cover, overhauled, and the woodwork painted where required.

Where maize and all summer-growing "hoed" crops are not too far advanced for the purpose, they should be kept in a well-cultivated condition with the horse hoe. Young maize and sorghum crops will derive much benefit by harrowing them, in the same direction as the rows are running, using light lever harrows with the tines set back at an angle to obviate dragging out of plants, but the work should not be done in the heat of the day.

Quick-maturing varieties of maize and sorghum may still be sown in the early part of the month in coastal areas where early frosts are not expected.

Succession sowings may be made of a number of quick-growing summer fodder crops—Sudan grass, Japanese and French millet, white panicum, and liberty millet (panicum). In favourable situations, both "grain" and "saccharine" sorghums may still be grown; also maize, for fodder purposes.

Fodder conservation should be the aim of everyone who derives a living from stock, particularly the dairyman; the present is an important period to plan cropping arrangements. Exclusive of the main crops for feeding off (when fodder is suitable for this purpose), ample provision should be made for ensilage crops to be conserved in silo or stack. As natural and summer-growing artificial grasses may be expected to lose some of their succulence in autumn, and more of it in winter and early spring, the cropping "lay-out" to provide a continuity of succulent green fodder throughout the season calls for thorough and deep cultivation and the building up of the fertility and moisture-holding capacity of the soil. Planter's friend (sorghum) may be sown as a broadcast crop at the latter end of the month for cutting and feeding to cattle in the autumn and early winter. Strips of land should be prepared also for a succession sowing about the second week in February, and for winter-growing fodder crops.

CLIMATOLOGICAL TABLE—OCTOBER, 1932.

Compiled from Telegraphic Reports.

Districts and Stations.	Atmospheric Pressure Mean at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Coastal.									
Cooktown	29·96	87	74	91	23, 24	68	26	Nil	..
Herberton	..	85	59	95	22–24	52	6	110	3
Rockhampton	29·98	87	66	99	23	60	22	122	8
Brisbane	30·02	78	60	86	14	52	10	297	11
Darling Downs.									
Dalby	29·99	79	54	86	5	40	10	292	13
Stanthorpe	..	71	46	78	5, 31	33	10, 20	248	14
Toowoomba	..	73	51	82	5	39	10	262	12
Mid-interior.									
Georgetown	29·89	98	70	106	24	62	7	11	3
Longreach	29·91	94	63	104	22	53	21	46	3
Mitchell	29·95	85	53	97	22	37	21	49	2
Western.									
Burketown	29·92	96	71	103	23	62	3	38	2
Boulia	29·92	93	58	108	24	49	3	37	2
Thargomindah	29·96	83	58	99	30	43	21	2	1

RAINFALL IN THE AGRICULTURAL DISTRICTS.

Table showing the Average Rainfall for the Month of October, in the Agricultural Districts, together with Total Rainfall during October, 1932 and 1931 for Comparison.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Oct.	No. of Years' Records.	Oct., 1932.	Oct., 1931.		Oct.	No. of Years' Records.	Oct., 1932.	Oct., 1931
North Coast.	In.		In.	In.	*South Coast*—continued—	In.		In.	In.
Atherton	0·91	31	0·46	1·11	Nambour	2·91	36	3·34	0·99
Cairns	2·15	50	0·49	5·23	Nanango	2·25	50	3·33	0·87
Cardwell	2·07	60	1·15	3·40	Rockhampton ..	1·75	45	1·22	0 50
Cooktown	1·07	56	0	0·15	Woodford	2 42	45	7·50	0·86
Herberton	0·97	46	1·10	0·57					
Ingham	1·96	40	0·52	3·35					
Innisfail	3·02	51	0·69	4·57					
Mossman Mill ..	3·17	19	0·77	4·46	*Darling Downs.*				
Townsville	1·41	61	0·10	3·68					
					Dalby	2 00	62	2·92	2·39
					Emu Vale	2·14	36	3·30	1·00
Central Coast.					Jimbour	1·87	44	2·52	1·91
					Miles	1·95	47	2·20	1·84
Ayr	1·00	45	0	1·09	Stanthorpe ..	2·54	59	2·48	2·16
Bowen	1·05	61	0	0·82	Toowoomba ..	2·55	60	2·62	1·31
Charters Towers ..	0·69	50	0·60	1·01	Warwick	2·28	67	3·63	1·33
Mackay	1·69	61	0·21	1·18					
Proserpine	1·74	29	0·08	0·90					
St. Lawrence ..	1·73	61	1·53	0·24					
					Maranoa.				
South Coast.					Roma	1·73	58	1·11	0·72
Biggenden	2·19	33	4·37	2·53					
Bundaberg	1·97	49	6·23	1·47					
Brisbane	2·54	81	2·97	0·58	*State Farms, &c.*				
Caboolture	2·47	45	3·01	0·89					
Childers	2·47	37	5·17	2·26	Bungeworgorai ..	1·38	18	0·71	0·82
Crohamhurst ..	3·25	39	2·45	1·61	Gatton College ..	1·99	33	2·60	1·00
Esk	2·50	45	4·74	1·17	Gindie	1·33	33	1·54	0·33
Gayndah	2·34	61	3·59	2·38	Hermitage ..	1·86	26	..	0·97
Gympie	2·67	62	3·09	1·48	Kairi	1·06	18	..	0·88
Kilkivan	2·58	53	3·48	0·65	Mackay Sugar Experiment Station	1·42	35	0·28	0·94
Maryborough ..	2·61	60	5·90	1·28					

GEORGE E. BOND, Divisional Meteorologist.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S., AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	December, 1932.		January, 1933.		MOONRISE. Dec., 1932.	Jan., 1933.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					a.m.	a.m.
1	4·51	6·31	5·3	6·47	7·39	9·37
2	4·51	6·31	5·4	6·47	8·44	10·33
3	4·51	6·32	5·4	6·47	9·49	11·27
					p.m.	p.m.
4	4·52	6·33	5·5	6·48	10·51	12·21
5	4·52	6·33	5·6	6·48	11·47	1·15
					p.m.	
6	4·52	6·34	5·6	6·48	12·41	2·9
7	4·53	6·34	5·7	6·48	1·35	3·5
8	4·53	6·35	5·8	6·49	2·27	4·0
9	4·53	6·35	5·9	6·49	3·23	4·54
10	4·53	6·36	5·10	6·49	4·17	5·47
11	4·54	6·37	5·10	6·49	5·12	6·37
12	4·54	6·37	5·11	6·49	6·7	7·23
13	4·54	6·38	5·12	6·49	7·0	8·3
14	4·54	6·38	5·13	6·49	7·53	8·40
15	4·54	6·39	5·14	6·49	8·41	9·9
16	4·55	6·39	5·15	6·49	9·25	9·40
17	4·55	6·40	5·16	6·48	10·3	10·11
18	4·56	6·41	5·17	6·48	10·35	10·42
19	4·56	6·41	5·18	6·48	11·7	11·18
20	4·57	6·42	5·18	6·48	11·39	12·0
					a.m.	a.m.
21	4·57	6·43	5·19	6·47	..	12·49
22	4·58	6·43	5·20	6·47	12·10	1·48
23	4·58	6·44	5·21	6·47	12·45	2·52
24	4·59	6·44	5·21	6·47	1·21	3·59
25	4·59	6·45	5·22	6·46	2·7	5·8
26	5·0	6·45	5·23	6·46	3·3	6·15
27	5·0	6·46	5·24	6·46	4·7	7·18
28	5·1	6·46	5·24	6·45	5·14	8·19
29	5·1	6·46	5·25	6·45	6·22	9·14
30	5·2	6·47	5·25	6·44	7·30	10·9
31	5·3	6·47	5·26	6·44	8·36	11·5

Phases of the Moon, Occultations, &c.

5 Dec.	☾ First Quarter	7	45 a.m.
13 ,,	○ Full Moon	12	21 p.m.
21 ,,	☽ Last Quarter	6	22 a.m.
27 ,,	● New Moon	9	22 p.m.

Apogee, 10th December, at 10.12 p.m.
Perigee, 26th December, at 11.36 a.m.

Mars will be passing from west to east of Neptune at 6 p.m. on the 5th at a distance of rather more than 3 diameters of the Moon northward.

Mercury's movements, apparently westward amongst the stars on the border of Orphincus and Scorpio, will be arrested on the 14th, after which it will proceed steadily eastward in Orphincus.

The Australian summer Solstice will occur on 22nd December, when the Sun reaches its most southern point, after which it will gradually retire northward for the next six months.

An interesting conjunction of the Moon and Saturn will occur early in the evening of the 29th, when the planet will be 3 degrees northward of the crescent-shaped Moon, about an hour and a-half before they set.

Mercury, in conjunction with the Sun on the 4th, will set 39 minutes after it on the 1st of December at Warwick; on the 15th it will rise at 3.48 a.m., one hour seven minutes before the Sun.

Venus will rise at 2.59 a.m. on the 1st and at 3.1 a.m. on the 15th.

Mars will rise at 12.18 a.m. on the 1st and at 1139. p.m. on the 15th.

Jupiter will rise at 12.53 a.m. on the 1st and at 12.1 a.m. on the 15th.

Saturn will set at 10.15 p.m. on the 1st and at 9.22 p.m. on the 15th.

The Moon's path during December will be in Sagittarius on the 1st, in Capricornus 2nd and 3rd, in Aquarius 4th and 5th, in Pisces 6th, 7th, and 8th, in Aries on the 9th, in Taurus 10th, 11th, 12th, and 13th, in Gemini 14th and 15th, in Cancer 16th and 17th, in Leo 17th, 18th, 19th, and 20th, in Virgo 21st, 22nd, and 23rd, in Libra on the 24th, in Scorpio 25th, in Orphincus 26th, and again in Sagittarius on the 27th and 28th, in Capricornus on the 29th and 30th, and in Aquarius on the 31st.

Instead of the full Moon on Christmas Day as last year, the evening will be moonless, affording better opportunities for noticing the constellations, including Aquarius, Pisces, Aries, Taurus, Gemini, and Cancer, arching from west to east, somewhat to the north. Another arch from Orion to the Southern Cross will include Sirius and Canopus, the finest fixed stars. The Southern Cross will be below the horizon in Queensland till nearly 10 o'clock.

4 Jan.	☾ First Quarter	2	24 p.m.
12 ,,	○ Full Moon	6	36 p.m.
19 ,,	☽ Last Quarter	4	15 p.m.
26 ,,	● New Moon	9	20 a.m.

Apogee, 7th January, 11.36 a.m.
Perigee, 23rd January, 12.48 p.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 23 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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